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ElectronicsWeek®

HE MAGAZINE OF THE WORLDWIDE ELECTRONICS INDUSTRY

29 MAY

KEYING UP FOR TOMMOROW'S OFFICE

PBXs INTEGRATE VOICE AND DATA
PAGE 57

Programmable controllers are taking over the factory/30

Part 2 of special report on Asia: The four dragons in the race/48

The RTP-650A data recorder puts sophisticated microprocessor intelligence at your fingertips.

The EL display is the natural man-machine interface. It immediately lets you check any aspect of recorder operation . . . self-tested results, set-up status, and recording or reproduced signal level. It also prompts you to the next key operation. Interactive function keys with on-screen labels have greatly simplified menu-driven set-ups of input levels, ID codes, calibration, and others. Further, you can pre-program eight different protocols on these set-ups for quick and easy error-free operation at a busy measuring site.

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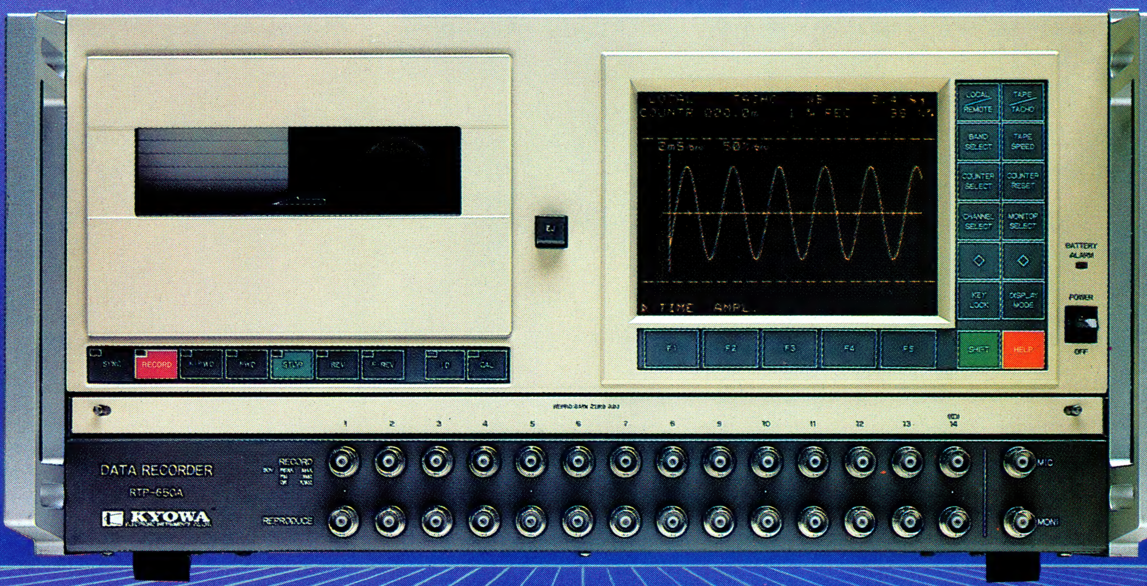

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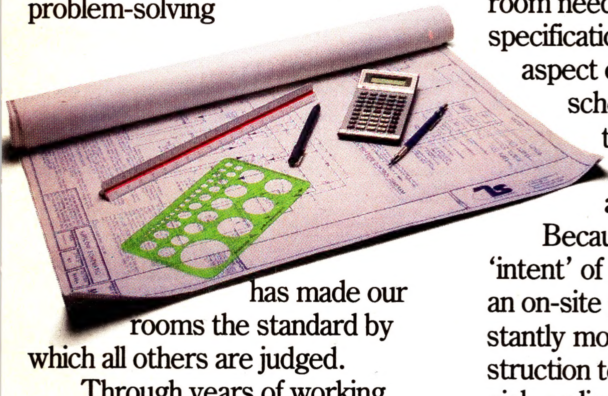

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PREVIEWS

Next ElectronicsWeek

The parallel computer takes another commercial step

The computer community has been waiting a long time for a massively parallel computer architecture that is commercially feasible. Several companies are working to turn multiple parallel-processor designs into products, universities are pushing research into the machines, and several models have actually made it to market. One of them, the Flex/32 Multicomputer, will be described next week in Technology Readout.

Field-service departments begin to earn their keep

The big computer and telecommunications manufacturers have traditionally regarded their field-service departments as cost centers: they produced no income and usually were isolated somewhere in the sales and marketing maze. But that description is changing, because as equipment becomes more complex, field service becomes more valuable. Not only that, but in some companies the department has actually become a profit center. Find out how next week in *ElectronicsWeek*

Looking ahead in ElectronicsWeek

Custom IC conference gains stature

The Custom Integrated Circuits Conference is growing in size and importance—which is not surprising, considering that the custom-chip business is the fastest-growing segment of the semiconductor industry. The mid-May seventh edition of the conference, to be held in Portland, Ore., will feature 120 papers from around the world. For a look at the meeting, with its emphasis on such topics as computer-aided design and the associated tools, standard cells, gate arrays, and full-custom designs, see the May 20 issue of *ElectronicsWeek.*

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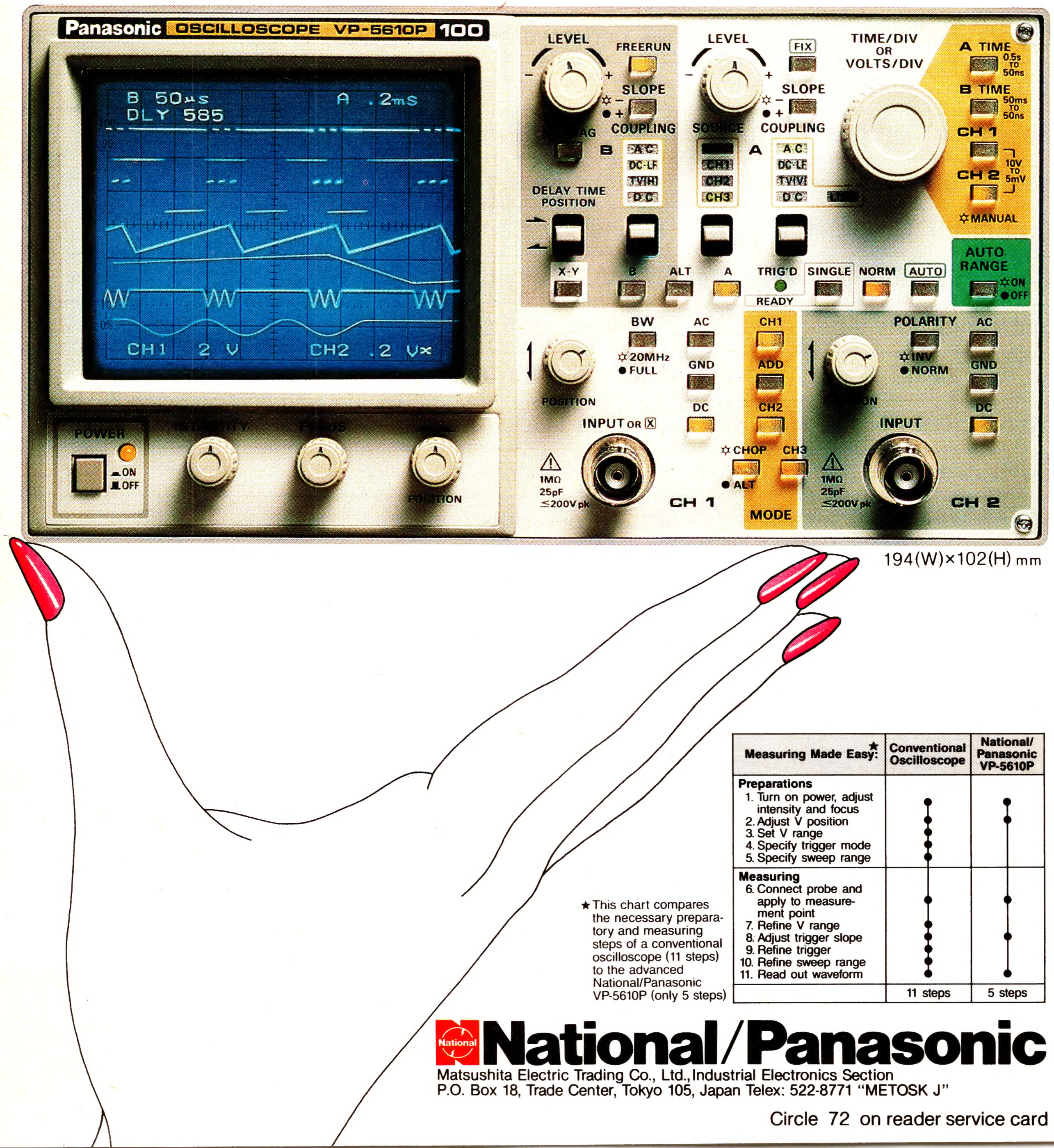

194(W)×102(H) mm

Measuring Made Easy:★	Conventional Oscilloscope	National/ Panasonic VP-5610P
Preparations		
1. Turn on power, adjust intensity and focus	●	●
2. Adjust V position	●	●
3. Set V range	●	
4. Specify trigger mode	●	
5. Specify sweep range	●	
Measuring		
6. Connect probe and apply to measurement point	●	●
7. Refine V range	●	
8. Adjust trigger slope	●	●
9. Refine trigger	●	
10. Refine sweep range	●	
11. Read out waveform	●	●
	11 steps	5 steps

★This chart compares the necessary preparatory and measuring steps of a conventional oscilloscope (11 steps) to the advanced National/Panasonic VP-5610P (only 5 steps)

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THE VOICE OF THE INDUSTRY, HEARD EVERY MONDAY

MOLECULAR ELECTRONICS

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DYNAMIC

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MEETINGS

1985 Eastern Design Engineering Show and ASME Conference, Cahners Exposition Group (999 Summer St., Stamford, Conn. 06905), Bayside Exposition Center, Boston, June 3-5.

International Conference on Consumer Electronics, IEEE (M. Gottlieb Associates, 6009 N. Milwaukee Ave., Chicago, Ill. 60646), The Westin Hotel, O'Hare International Airport, Rosemont, Ill., June 5-7.

Computer Vision and Pattern Recognition, IEEE (Computer Vision and Pattern Recognition, P.O. Box 639, Silver Spring, Md. 20901), Cathedral Hill Hotel, San Francisco, June 9-13.

Second Probe Research International Conference on Voice Processing, Probe Research Inc. (Rita Tannenbaum, PRI, P.O. Box 590, Morristown, N.J. 07960), Waldorf Hotel, London, England, June 10-11.

Vacuum Processing Technology '85, New England Combined Chapter of the American Vacuum Society (Terri D. Berker, Polaroid Corp., 750 Main St., Suite 3-G, Cambridge, Mass. 02139), Sheraton-Tara Hotel, Nashua, N.H., June 10-11.

Cogeneration Systems, The Energy Bureau (41 E. 42nd Street, New York, N.Y. 10017), Sheraton Crystal City, Arlington, Va., June 10-11.

Transformation of Work in the Information Age, Information Institute of the International Academy at Santa Barbara (2060 Alameda Padre Serra, Santa Barbara, Calif. 93103), Santa Barbara Sheraton Hotel, Santa Barbara, June 10-11.

Telecommunications Planning in an Era of Uncertainty, Gartner Group Inc. (Lynn Bentley, Gartner Group, 72 Cummings Point Rd., Stamford, Conn. 06902), Hyatt Islandia, San Diego, June 10-12.

ATE East '85 Conference & Exhibit, Morgan Grampian Expositions Group (1050 Commonwealth Ave., Boston, Mass. 02215), Sheraton-Boston Hotel, Boston, June 10-13.

Microset/Office Automation, Engineering Society of Detroit (100 Farnsworth Ave., Detroit, Mich. 48202), Hyatt Regency, Dearborn, Mich., June 11-13.

1985 Plant Engineering & Maintenance Show and Conference/East, Cahners Exposition Group (999 Summer St., Stamford, Conn. 06905), Georgia World Congress Center, Atlanta, June 11-13.

Tool and Manufacturing Engineering Conference and Exposition, Society of Manufacturing Engineers (1 SME Dr., Dearborn, Mich., 48121), Buffalo Convention Center, Buffalo, N.Y., June 11-13.

Summer 1985 Usenix Conference and Exhibition, Usenix Association (P.O. Box 385, Sunset Beach, Calif. 90742), Portland Marriott Hotel, Portland, Ore., June 11-14.

Image Science '85, International Commission of Optics *et al.* (Image Science '85, Helsinki University of Technology, Laboratory of Graphic Arts Technology, Tekniikantie 3, SF-02150 Espoo 15, Finland), Helsinki University of Technology, Helsinki, Finland, June 11-14.

Info/West—The Western Information Management Exposition & Conference, Cahners Exposition Group (Show Manager, Info/West, 999 Summer St., Stamford, Conn. 06905), Anaheim Convention Center, Anaheim, Calif., June 12-14.

Seminars

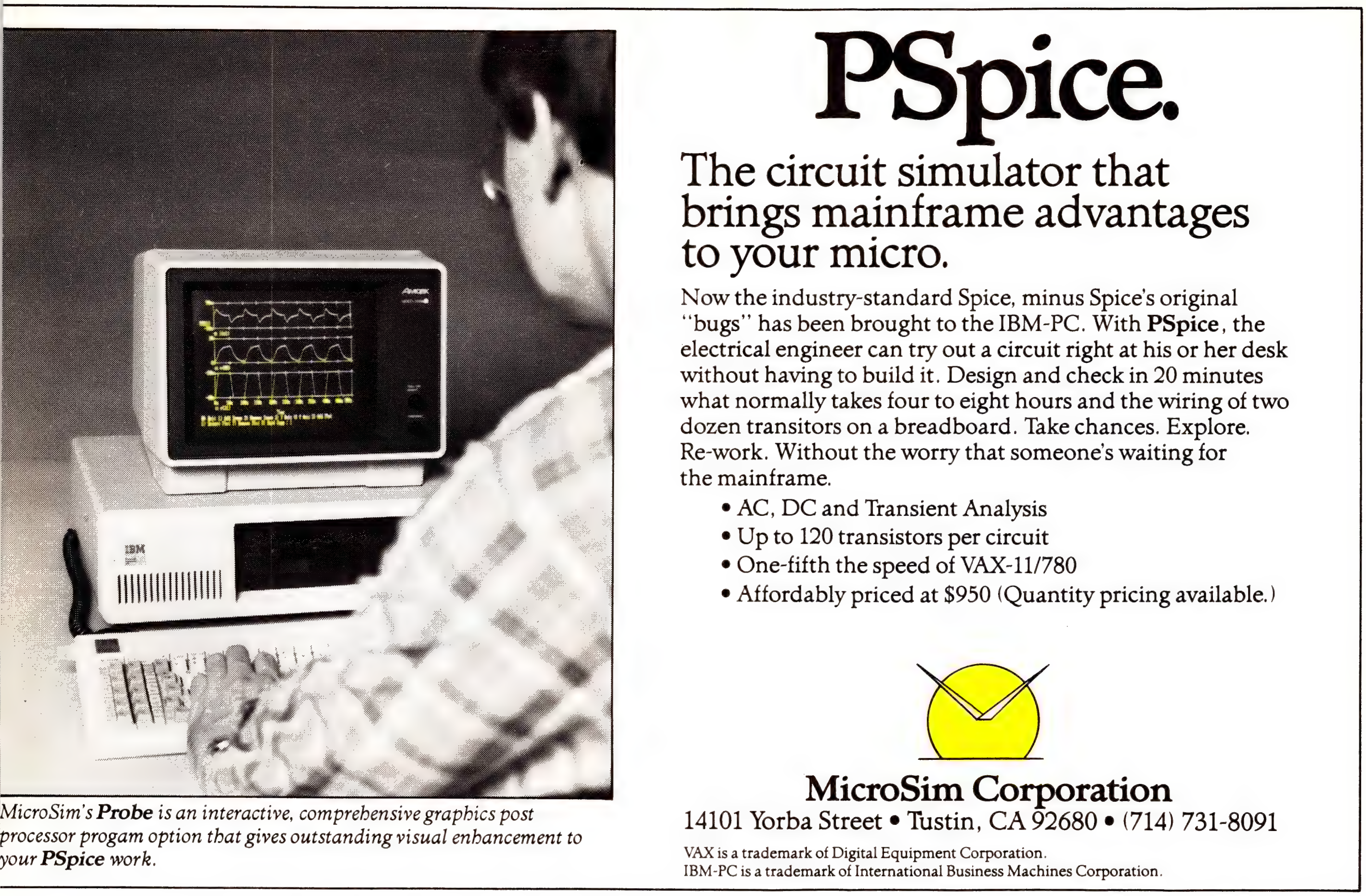
Building Expert Systems—An Assessment of the State of the Art, Software Architecture and Engineering Inc. (1500 Wilson Blvd., Suite 800, Arlington, Va. 22209), Sheraton Rodeo, Sunnyvale, Calif., June 6-7; Newporter, Newport Beach, Calif., June 10-11.

Networking, Protocols, and Compatibility, Datapro Research Corp. (1805 Underwood Blvd., Delran, N.J. 08075), Marriott Downtown, Chicago, June 10-11.

Telecommunications II: Integrated Voice/Data and Digital PBX, Datapro Research Corp. (Seminar Department, Datapro Research, 1805 Underwood Blvd., Delran, N.J. 08075), Marriott at Fisherman's Wharf, San Francisco, June 10-11.

Networks Operations and Management, Systems Technology Forum (9000 Fern Park Dr., Burke, Va. 22015), The Barbizon Plaza Hotel, New York, June 10-12.

Introduction to MAP and Related OSI Protocols, CASA/SME (Sally Davis, Special Programs Division, 1 SME Dr., Dearborn, Mich. 48121), Hyatt Regency, Dearborn, Mich., June 11-13.



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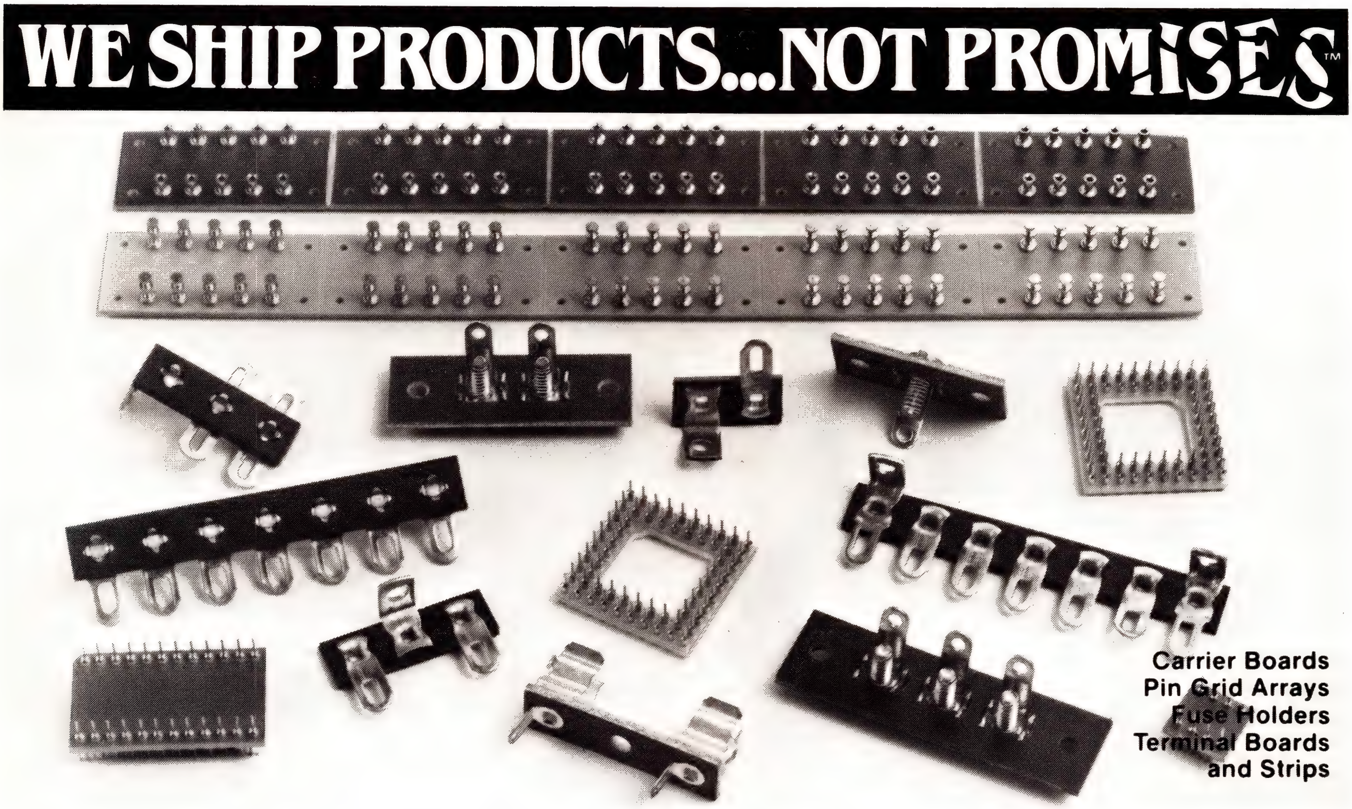

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UP FRONT

Water board orders chip firms to get moving on chemical cleanup

The San Francisco Regional Water Quality Control Board last week unanimously ordered the "Mountain View 5" (Fairchild, Intel, NEC, Raytheon, and Siltec) to stop stalling in their work to clean up massive toxic chemical spills discovered over three years ago in Silicon Valley [*ElectronicsWeek*, March 18, 1985, p. 32]. Since the spills were documented in September 1982, plumes of contaminants have merged in the groundwater, making the assignment of responsibility among the firms difficult. During a public hearing, Mountain View mayor Jim Zesch called for a "timetable with teeth" to protect his citizens from the spills, located only a half mile from a city drinking well. The five have only 90 days to work with the water board and the State of California to devise an amenable cleanup plan. If neither the board nor state legislation can get the ball rolling, the Environmental Protection Agency is authorized to use Superfund monies to aid the cleanup; later, if the firms are found negligent, the EPA can sue for treble the cleanup's cost. ☐

Sony in joint effort to enter U.S. robot market

Sony Corp. will enter the U.S. robot market this summer through a new tie-up with Nissho-Iwai Trading Co. The firm will display three products, the SRX-2CH and SRX-2DH high-speed assembly robots and the ACX-10 multitask assembly system, at June's Robot IX exhibition in Detroit. Both assembly robots are 2-to-4-axis machines, with high-precision positioning ability within 50 μm. Maximum operating speed for the models is 4.1 and 4.0 meters/s, respectively. A 16-bit central processing unit provides smoother acceleration and deceleration, Sony says, and can store up to 16 programs of various lengths. The LUNA (Language for User's Needs and Aims) language is used to instruct the robots. The ACX-10 was originally developed for automatic assembly of video cassette recorders and mini tape recorders. ☐

Open up VHSIC eligibility, Sperry asks Pentagon

Sperry Corp. wants the Defense Department to open the insertion phase of its Very High-Speed Integrated Circuit (VHSIC) program to firms other than the original seven Phase 1 contractors. In announcing Sperry's interest in the insertion phase of VHSIC, Neil Hahn, manager of ground systems marketing at its Defense Products Group in St. Paul, Minn., said, "By allowing any contractor with a legitimate [Phase 1] process to compete in the [insertion-phase] bidding, it would lower the cost of the insertion, speed up the schedule, and encourage innovative solutions." In the insertion phase, VHSIC devices will be used in actual systems. Sperry makes 19 VHSIC-qualified parts with its 1.2-μm CMOS process. ☐

Poor business climate doesn't deter new products at Comdex/Spring

Fair weather but a foul business climate will greet the 750 exhibitors and some 50,000 participants as the 1985 Comdex/Spring show opens today. A slowdown in the small computer systems market has not deterred some firms from aggressive new product introductions. For example, Hayes Microcomputer Products Inc. will show a multifunction print and communications buffer. Called the Transet 1000, the device lets personal computer users receive data without having to stop what they're doing on the computer. It combines a printer controller and buffer, communications buffer, port expander, and input/output switch. Also undismayed by the economic climate is Thomson Grand Public, the $2 billion French consumer electronics arm of Thomson S.A. It has formed Thomson Consumer Products Corp. and will show its new color and monochrome monitors at Comdex. ☐

UP FRONT

Japanese firm gets AI expertise from U.S. joint venture

A joint venture linking Pittsburgh's Carnegie Group Inc. and Tokyo's Intelligent Technology Inc. could be a major step in spreading artificial-intelligence expertise around the world, the two firms believe. Surfacing last week at the AI 1985 conference in Long Beach, Calif., the pact gives ITI the right to distribute the Carnegie Group's AI software-development tools—Knowledge Craft and Language Craft—throughout East Asia. Initial joint-development work will concentrate on Japanese-language versions. The privately held Carnegie Group sees the alliance with ITI as a way to penetrate the Japanese market. □

VLSI Technology kicks off line of LSI-function Megacells

Difficulties with using very large-scale standard cells in semicustom chip design include "megaholes"—large tracts of wasted chip real estate when, for instance, three large cells are placed on a square die. VLSI Technology Inc. of San Jose, Calif., introduced last week the first two members of its Megacell series—the VGC6845 cathode-ray-tube controller and a 16- to 128-K read-only memory—which, when interconnected on-chip by VTI's Megabus, help solve the problem. VTI expects to bring a significant number of what are now LSI functions to the bus so they can be combined arbitrarily using the firm's silicon compilers and other chip-design tools. The firm is designing Megacells specifically for its bus and with standard dimensions to avoid wasting real estate, rather than adapting existing LSI designs. More functions will be added to the library before year end, say officials. □

Xerox kicks off two-year office-automation push

With plenty of fanfare and a nine-city satellite link, Xerox Corp. last week introduced 10 computer and communications products, two printers, and several document-distribution software packages, launching a drive that some see as a last-ditch effort to become the heavyweight champ of office automation. At the center of the computer announcements were revamped versions of the Ing. C. Olivetti & C. personal computer—also being marketed by AT&T Co. as the PC 6300—and a high-end single-user work station dubbed the 6085 PCS, built around the proprietary 16-bit Mesa processor and a pair of Intel-supplied 80186 coprocessors, one for input/output control and another for optional IBM Corp. Personal Computer emulation. Among the other announcements were: plans to market AT&T's 1-Mb Starlan local-area-network hardware; support for the low-cost RG-58 cable implementation of Ethernet (dubbed Cheapernet); and a 10-pages/min laser printer, featuring a 5,000-pages/month duty cycle and intended to regain ground lost to Japanese vendors. □

Datapoint sees quarterly loss, enters marketing pact with Fujitsu PBX unit

Datapoint Corp. is trying to reassure its customers that it remains a strong, viable business that will continue in operation, chairman Asher B. Edelman said last week. However, Edelman, who won control of the firm through a Wall Street proxy battle, also said the firm will lose about $20 million in this year's third fiscal quarter, which ends April 30. In the same period last year, it earned about $8 million on revenues of $155 million. "We expect to break even in the [fourth] quarter," he added, with profitability coming in the first quarter of fiscal 1986. Datapoint has signed a joint marketing agreement with Fujitsu Business Communications, a unit of Fujitsu America Inc. Datapoint's products will be offered through its partner's distribution channels, while the Datapoint sales force will offer Fujitsu's private branch exchange. □

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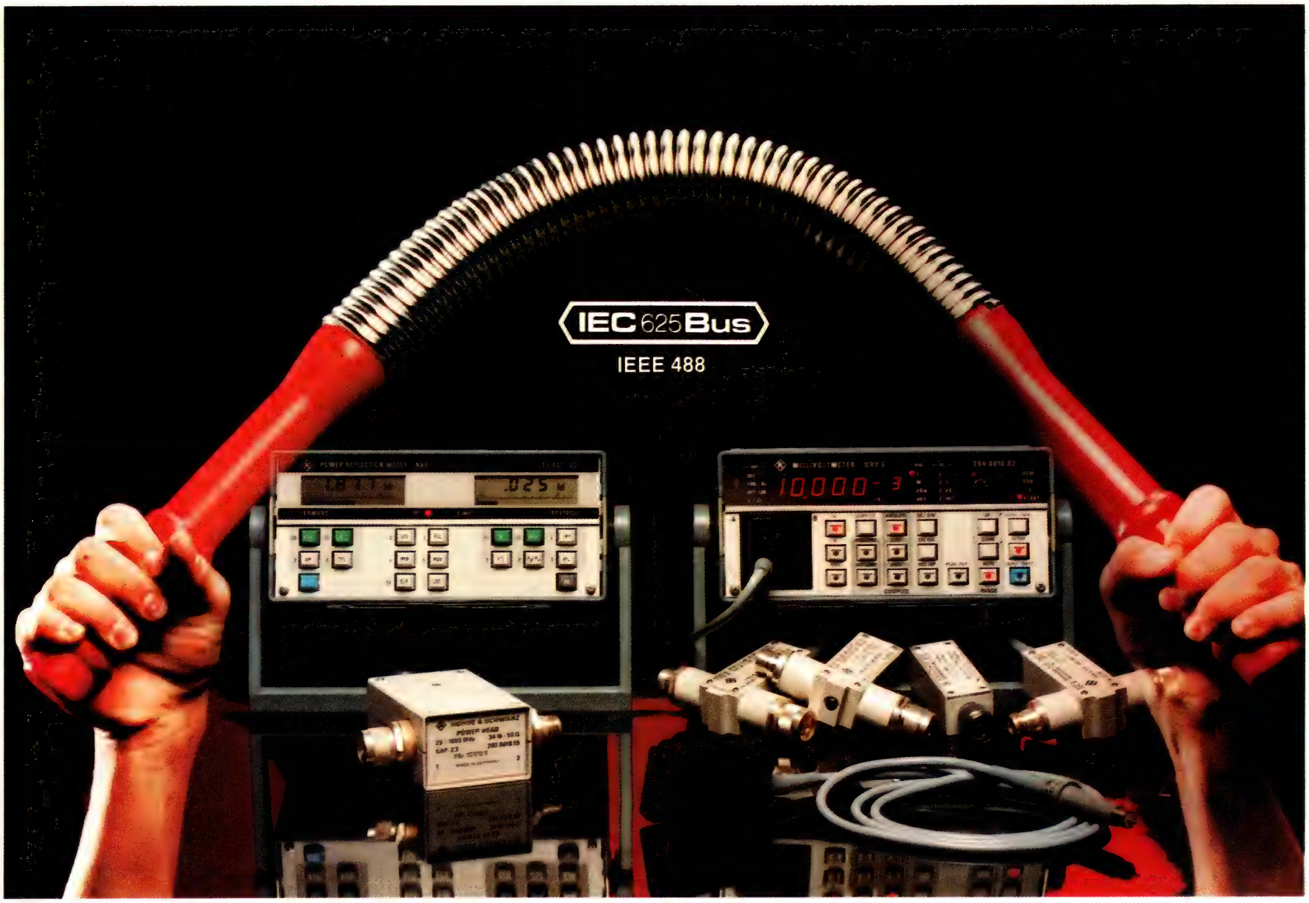

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Sitting pretty. Japanese vendors of graphics gear may not lead the world in software, but their hardware quality and price-performance are hard to beat, observers say.

leading Japanese maker of drafting machines, is rapidly becoming a contender in graphics displays too. Mutoh has just introduced a product that industry observers say has an excellent price-performance ratio. In January, the firm began marketing in Japan its Sapiens model MG-310S two- and three-dimensional intelligent graphics terminal. Already well received, the terminal has high resolution—1,400 by 1,024 pixels—and it can display 16 standard and 120 intermediate colors at one time with a display-output speed of 200 ns/dot—all achieved by hardware rather than software.

Again, the technology is not innovative, but the price is hard to beat: the Sapiens package with software sells for about $20,000. A comparable system from a U.S. manufacturer would be about $30,000, claims Kazz Shimazaki, a senior staff member of the operations division at Mutoh.

Prime's Yaginuma points out that some graphics terminals in the U.S. are selling for as much as $40,000 to $80,000. "The market in Japan won't support that kind of product. A user here would never pay that just for a graphics terminal." Although Mutoh doesn't yet ship its new model to the U.S., Shimazaki of Mutoh says that is the company's aim.

In August, Mutoh will begin shipping another new product—a high-performance professional plotter—that may affect the graphics market even further. This time, the product is not only out-pricing its U.S. competition, it is also outperforming it. Mutoh's new plotters, Model F-600 and F-900, have a maximum drawing speed of 1,131 mm/s, almost twice as fast as Hewlett-Packard Co.'s HP 7580B model, which has a maximum speed of about 600 mm/s.

Less expensive. In addition, Mutoh's plotter has a maximum acceleration speed of 5.7 g and a minimum setting of 0.01 mm, compared with the Hewlett-Packard machine's acceleration of 4 g and setting of 0.0254 mm. At $15,400 and $18,400, Mutoh's two F-900 plotters are 5% cheaper than its competitor.

But some of Japan's biggest computer graphics firms did not even bring their best wares to the show. Last November, for instance, Hitachi Ltd. announced the development of a new superhigh-resolution color graphics monitor that has more than 4 million pixels (2,448 by 2,048). Compatible with its Gradas computer-aided-design and -engineering system, the 3-d monitor has an extremely rapid shading and display speed of 350 to 1,300 faces/s and up to 16 million colors. All this comes packaged in a 20-in. picture tube. However, Hitachi Ltd. wasn't at the show. The sole Hitachi group representative was Hitachi Zosen, the shipbuilder, which displayed a CAD/CAM system.

Nippon Gakki Ltd., maker of Yamaha musical instruments, exhibited its new YGT-1000 color graphics terminal. Its resolution of 1,024 by 800 pixels is good but not comparable to other products on the market.

–Jonathan Joseph

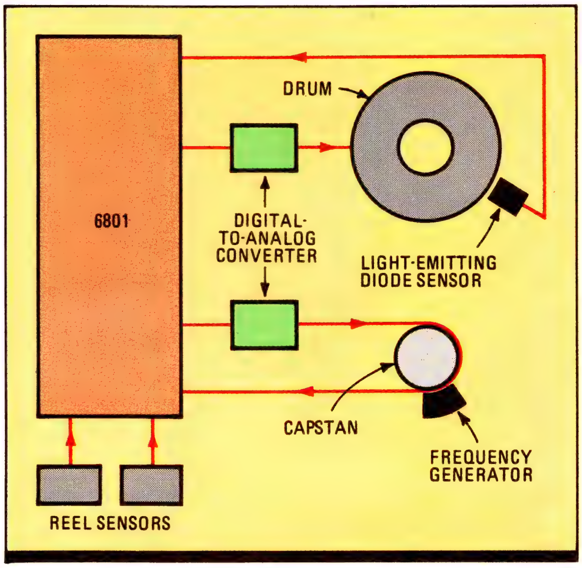
CONSUMER ELECTRONICS

THOMSON'S VCR SYSTEM CLEARS UP DOUBTS

Villingen, West Germany

Confounding the industry skeptics, Thomson SA has developed an original digital control system for video cassette recorders that improves picture quality. In addition, the new system also offers a more accurate and easier-to-control VCR mechanism.

The new system, developed at Thomson's principal consumer electronics research laboratory here, grew out of a licensing agreement in May 1983 with the Japanese Victor Corp. to make VCRs compatible with JVC's standard. Back then, Thomson officials said the pact was only a base from which it would develop its proprietary approach to VCRs. Most industry observers were skeptical about the success of Thomson's efforts in this end of the consumer electronics business, but these skeptics



Loop the loop. Based on a digital reference signal and microprocessor control, Thomson's DQS improves video cassette recorder performance. A bonus is the addition of several features.

seem to have missed their bet.

Called the DQS (for digital quartz servo), the system replaces the analog circuitry in the form of a phase-locked loop that is currently used to synchronize a VCR's mechanical drive mechanism with a microprocessor-generated digital reference. The signal's accuracy means significantly improved resolution, reduced color noise, and highly stable still pictures.

With microprocessor control, Thomson can add features that standard VCRs lack. For example, instead of a standard tape counter that gives the position of the tape relative to its starting point, the DQS uses the capstan speed to calculate the real length of the tape and tell the user at which point he is in terms of time with a resolution of 1 min per 4 h.

Thus a standard 120-min cassette might give a reading of 2 h, 04 min and tell the user that he is at minute 18. After the reading, the system keeps updating the user's position on the tape, regardless of any playing, fast forward, rewind, and reverse operations that are performed. The user can also command the VCR to go to any spot on the tape by keying in a Go To command with the corresponding time as the address and can advance from frame to frame while the DQS calculates the optimized still picture for each relevant track.

The heart of the system is a Motorola 6801 microprocessor to which are connected a 4-MHz quartz oscillator, a light-emitting diode sensor to detect the speed of the recording and reading drum, a frequency generator whose output frequency varies as a function of the speed of the mechanism's drive capstan, and two mechanical sensors to detect the speed of the two reels.

Data conversion. With the oscillator as a reference, the microprocessor uses input from the light sensor and frequency generator to calculate the optimal speeds of the recorder's mechanical parts. This data is then converted into two analog signals to drive the drum and capstan. The constant updating of these signals virtually eliminates the aging effects that can cause picture deterioration in an old recorder.

When a cassette is loaded into the machine, two mechanical speed sensors at the reels permit the microprocessor to calculate in 10 s the length of the tape and its immediate position using a secondary derivation of the differential speed of the two reels. This data is then stored in the processor's memory and updated as the machine is used.

Erich Geiger, managing director of Thomson's Consumer Research and Development Laboratories, expects DQS-based machines to be in production by summer. *–Robert T. Gallagher*

MICROSYSTEMS

MAKERS OF ADD-ONS RACE TO OUTSTRIP IBM

Carrollton, Texas

A growing corner of the graphics-processing business continues to do well by improving the image of IBM Corp. Personal Computers. The result is an explosion of design-automation software for IBM PCs that increases the need for much faster, higher-resolution color displays.

It is not hard, then, to picture why industry analysts believe it is only a matter of time before IBM introduces its own color-graphics add-on board to boost the display resolution of its PCs to 1-K horizontal lines from the current level of 640 dots by 350 lines. Many expect an introduction by midsummer.

That prospect has many small vendors of add-on graphics cards readying the next round of controllers that will be capable of yet greater resolutions, more color planes, and faster drawing speeds. Such a card from Advanced Computer Solutions International Inc., of Carrollton, a Dallas suburb, offers 2.5 megabytes of on-board graphics memory. The random-access memory holds data for 20 million pixels and is enough to fill four 19-in. screens with 1-K-by-1-K pixel resolution.

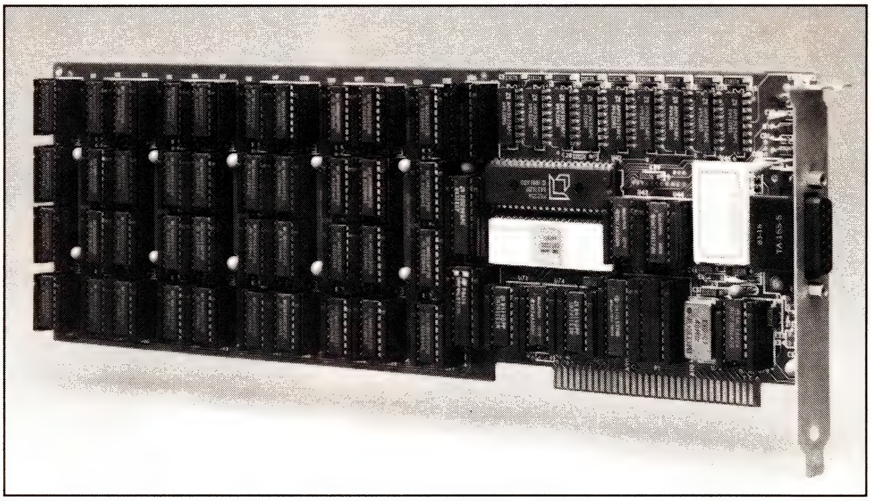
Window on memory. The 2.5 megabytes of on-board memory—made possible by double-stacking chip sockets with one 256-K dynamic RAM atop another—speeds up displays by reducing access time. The storage space often eliminates the need to redraw graphics, because the display area of the screen is actually a "window" panning the 2,048-by-2,048-pixel memory space, says company president Om P. Singla.

Instead of using dual-ported RAM and a more conventional bit-mapped processing scheme, ACS International opted to use the large memory space and a vector-drawing routine aimed at speeding the execution of figures common in computer-aided design applications. Based on NEC Ltd.'s 7220 graphics processor, the board, called Graphax, will process 1.2 million pixels/s with burst rates of 10 million.

"It's a tradeoff issue. Bit-mapped graphics and dual-ported memories offer greater flexibility, such as shading of images for drawings," notes Singla. "But the vector-oriented schematics of engineering work stations [such as circles, lines, and arches] are executed faster with vectors." The board sells for $2,995, making the cost of a ready-to-use IBM PC AT-based work station with application software $15,000 to $18,000.

Personality. Graphics-industry analyst Ken Anderson, who publishes "The Anderson Report" in Simi Valley, Calif., believes high-resolution display controllers for IBM PC/XT and PC AT models are one of the leading factors in "changing the personality of the PC into engineering work stations." He adds, however, that vendors of add-on graphics boards will likely soon face stiff competition from IBM, which may not match the highest performance levels from third-party suppliers but will capture market share with the influence of its name. "Customers might be willing to accept a little less resolution and speed to be certain of software compatibility for the next five years," he adds.

Like other graphics-hardware suppli-



Packed board. A graphics card for the IBM Personal Computer, from Advanced Computer Solutions International, has 2.5 megabytes of on-board graphics memory. It manages that density by having double-stacked chip sockets with 256-K dynamic RAMs atop each other.

ers for IBM PC models, ACS International officials are confidentially welcoming competition with the computer giant. Their firm plans to support a number of emerging standards such as the IBM-backed virtual device interface and the Graphics Kernel Standard.

"We hope IBM comes up with a 1-K-by-1-K board because it will legitimize the market, and you will soon see 200 more firms writing software for the PC," says Singla. IBM engineers visited his firm's small booth during the recent National Computer Graphics Association Conference in Dallas and "were definitely interested in what we were doing, but the reason for their visit was not totally clear." *–J. Robert Lineback*

INSTRUMENTS

DOT-MATRIX LCD SHRINKS SOAR'S DIGITAL SCOPE

Cherry Hill, N.J.

With the portable digital test equipment that is beginning to appear, users can easily obtain more meaningful field measurements than before. A key to miniaturizing test equipment is replacing the cathode-ray-tube display with solid-state versions. One new product, which appeared just last week, is a digital storage oscilloscope that uses liquid-crystal-display technology; another new scope uses light-emitting diodes.

Although small-screen LCD scopes are no novelty, North American Soar Corp. has added a new twist: replacing the standard CRT is a flat-panel dot-matrix LCD with a 128-by-256-dot screen that measures 5½ by 3½ in. The entire scope, 12¼ by 6¼ by ⅝ in., weighs in at 6 2/3 lb.

The model 1020 oscilloscope can run on four D batteries or with an external ac adapter. North American Soar president Robert J. Liska is expansive about possible applications. "We're looking at everything from telecommunications to computers," Liska explains. The scope can be used in local-area networks, cellular telephones, and on board aircraft, he says.

The 20-MHz unit includes a dual-trace capability with freeze frame and the choice of sequential sampling or 100-kHz in real time. By sampling waveforms sequentially, "we catch the glitches coming through and display them," he explains. In addition, alphanumerics in the LCD screen indicate the peak-to-peak voltage value, period, and dc component. The portable oscilloscope, which will sell for $2,830, also has an 8-bit-by-2-K memory. Liska says it will be available from North American Soar's headquarters here within 60 days.

LED device. Pocket Technologies Inc., of Hanover, Md., uses LEDs to reduce the size of its test equipment even further. The firm's Logicscope, measuring only 8 by 4½ by 1¾ in. and weighing just 1¼ lb, has an array of 400 LEDs in four rows of 100 each.

The 10-MHz device combines useful features of oscilloscopes—such as dual-trace display of digital waveforms—with a logic analyzer's ability to compare waveforms, says Michael Heilman, Pocket Technologies' sales manager. He maintains that LED technology allows the device to switch faster than LCD displays such as Soar's, to provide a real-time mode. He adds that the firm also plans an advanced model with a faster bandwidth, presumably 20 MHz, and an analog display.

Portable. North American Soar Corp. has reduced the size of its scope by replacing the conventional CRT with LCD technology. The instrument weighs just 6 2/3 lb, and its display, 128 by 256 dots, measures 5½ by 3½ in. It can run on four D batteries or with an ac adapter.

In addition to its real-time mode, the oscilloscope can operate in a memory mode, storing 50- to 100-bit waveforms. These stored waveforms can later be compared with other input waveforms.

By combining markets for scopes, logic analyzers, logic probes, and hand-held multimeters, Heilman estimates the current market for products similar to the Logicscope at $1.7 billion, advancing to $2 billion in 1986. He believes his firm may have a leg up on competitors like Soar, however, because the Logicscope is priced at $595. *–George Leopold*

SOFTWARE

OPEN-ARCHITECTURE VERSION OF PICK ADDS FLEXIBILITY

Irvine, Calif.

Unveiling an open-architecture version of an operating system that is nearly 20 years old does not figure to turn many heads in the microcomputer business, which lends an increasingly deaf ear to the steady din of such announcements. But this newest development of the operating system from Pick Systems Inc. already has stirred more than a passing interest, reflected by more than a dozen licensees who got their first look at a technical session here last week.

Pick, which has a base of more than 20,000 users, has won adherents over the years for its simplicity in business applications. A multiuser, hardware-independent system with built-in database management and virtual memory features, Pick was originally written for Microdata Corp.'s 8-bit Reality minicomputer. It now runs on the major 16-bit microprocessor-based machines, including the IBM Corp. Personal Computer/XT and compatibles.

By removing the restrictions of a closed programming structure and through rewriting and rearranging the code into a modular format, the open architecture allows new functions to be added easily. The previously closed structure made such additions impossible to do without disrupting existing programs, they note. Comparing the closed version and the new, a consultant to Pick Systems observed that "before, it looked like a ball of spaghetti. Now it is entirely cleaned up by restructuring."

The change, which took almost two years to complete, allows users and licensees to modify their operating environment, says Timothy J. Holland, senior vice president. Besides flexibility, the open architecture's features include multitasking and the ability to execute operating-system commands without exiting the application program being run. And now record size is limited only by hardware storage capacity; previously, the maximum was 32-K bytes.

A typical licensee reaction to the Pick development comes from Jay L. Kear, executive vice president and general manager of CIE Systems Inc., based here, whose CIES 680 microsystem family offers a Pick operating system, among others. "It gives us new handles, as the next iteration of what already is a very good system," he says.

Users have been asking for the features, so Kear's firm was "one of the first to sign up for the meetings." Another prospective development, planned for later in the year, also excites Kear: the new architecture makes it possible for one machine to run multiple operating systems simultaneously, so Unix or PC-DOS, for example, can run alongside Pick. *–Larry Waller*

MAINFRAME COMPUTERS

ICL BANKS ON NETWORKS AND JAPANESE CHIPS

London

Britain's last-ditch effort to stay in the mainframe computer business with the help of Japanese chip technology broke the surface late last month when International Computers Ltd. plc, the country's flagship computer company, launched its 3900 series, which has members that execute from 2.2 to a 40 million instructions/s (the latter in a promised four-processor version).

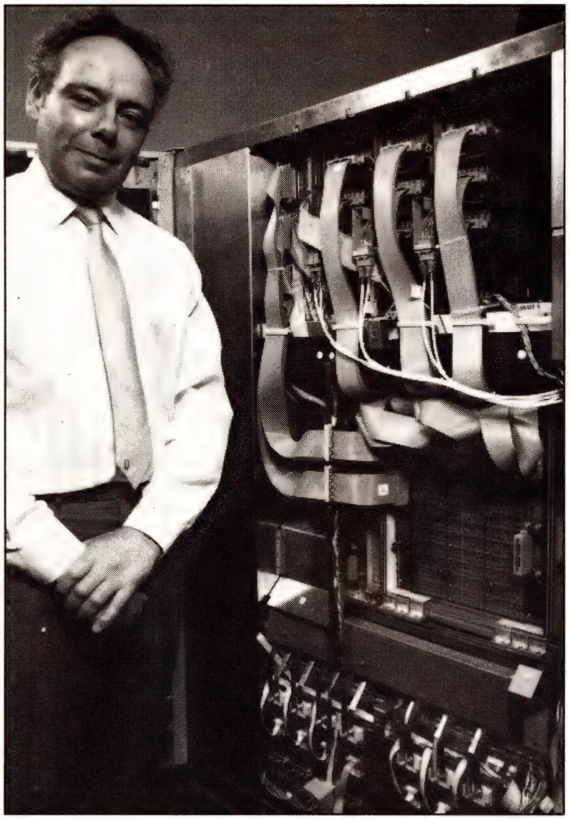
Plans for the series were put in place some four years ago when Robb Wilmot, then the 38-year-old managing director of Texas Instruments Inc.'s British subsidiary and now ICL's chairman, was brought in to sort out the stricken computer maker as part of a government rescue operation. On the technology front, Wilmot acted swiftly, signing an accord with Fujitsu Ltd. that gave the British company access to sorely needed chip and packaging technology.

Two new processors, the 2.2-mips Level 30 and the 11-mips Level 80, are the first fruits of ICL's Japanese connection. They break new ground on several fronts, most significantly by the use of a 50-Mb/s fiber-optic local-area network to link up to four processors and high-speed peripherals. A 10-Mb/s Ethernet is used to connect slower peripherals and support office networking, fulfilling Wilmot's promise to develop a fully networked product line.

Resilient. Besides containing development costs, ICL's multiple-processor strategy offers users a modular growth path and a degree of fault tolerance, or resilience. If one processor fails, the others can take over without user intervention. ICL is retaining its proven Virtual Machine Environment operating system and thus will be able to span a 25-fold performance spectrum with a single operating system, something few other manufacturers have achieved.

ICL is launching the series with single and dual versions of both processors. The dual 39/80 will deliver up to 22 mips. Prices are $180,000 for a single-processor 39/30 and $3.69 million for a dual-processor 39/80.

Each processing node in this multiprocessor setup comprises a basic processor, storage, network controllers, and a small diagnostic microprocessor to keep an eye on things—checking cabinet temperature, logging memory errors and lost processor instructions, and carrying out diagnostic routines. If a failure occurs, the diagnostic processor can be linked by telephone to a terminal in ICL's service center.



Networked line. ICL's Level 80 computer talks to its brethren through an optical bus and to an Ethernet. Ethernet ICs were unavailable when design work began, says David Dace.

Both processors also feature ICL's high-speed data-base searching device. Called the Content Addressable File Store Information Search Processor, it combines hardware and software techniques to search disk stores without tying up the central processing unit and can, for example, search the equivalent of 1,200 pages of text in 1 s.

But the success of the 3900 Series hangs not so much on smart ideas as on the price-performance ratio. This boils down to aggressive use of the best integrated-circuit technology. Wilmot, with a background in semiconductor technology, set ICL's development staff to do just that. To start with, says David Dace, director and general manager of ICL's mainframe systems division, "we decided to go for 256-K chips, and it has paid off. They are now selling for $4."

TTL dumped. For its smaller 39/30 processor, ICL dumped the TTL gate-array technology it had been planning to use and instead switched to Fujitsu's 8,000-gate CMOS array technology. ICL designed 43 array chips for the 39/30 processor and high-speed disk controller. The chips carry the equivalent of up to 30,000 transistors each and are housed in 179-pin ceramic packages.

Switching to cooler-running CMOS technology allowed ICL to produce "an office mainframe," declares Wilmot—the Level 30 is small enough to fit into the general office, yet it runs without air conditioning, consuming only about 800 W. The 39/30's 2.2-mips performance is sufficient to support 200 users in an environment with a mixed office workload. It is comparable in performance to a superminicomputer but with the added attraction of a secure mainframe operating system, says Wilmot.

"I am convinced that the supermini will disappear," says Wilmot. He sees it being challenged by the office mainframe at one end and by supermicrocomputers at the other.

For its high-performance 39/80, ICL uses emitter-coupled-logic chips with 0.4-ns gate delays. ICL designed 120 array chips of 800-gate complexity for the 39/80. The company uses the same packaging and interconnection technology as that used in the Fujitsu and Amdahl machines. In effect, Fujitsu provided ICL with a fully packaged high-density processor, called a cube. The technology avoids the complexities of water cooling, which is used by IBM; chips are cooled by forcing air over metal caps attached to each chip carrier. The chips are surface-mounted onto high-density circuit boards and delivered to ICL, where they are assembled into processor cubes.

ICL claims that a single 39/80 is 30% more powerful than a single-processor IBM 3083JX, and a two-processor system is said to have 75% of the power of the recently announced IBM 3090/200. The ICL machine, however, uses one quarter the space and power of its rival and incurs only a quarter of the installation and running costs.

Networking represents a major plank in ICL's revamped product strategy, and the 3900 series is the first to have networking built into its architecture. By replacing many input/output ports with one or two networking ports, a mass of cabling and line-driver circuitry is eliminated, saving space and power and improving reliability, says Dace.

One of ICL's two networking technologies is a wideband fiber-optic LAN called a Macrolan, which provides a 50-Mb/s highway for interconnecting node processors and fast disk and tape drives. Macrolan is a token-passing ring implemented as a star network. At its hub is a port switch with circuitry that allows it to bypass faulty sections. The fiber technology was developed in collaboration with the Plessey Co. plc.

On a limb. Slower peripherals and office terminals are connected through a 10-Mb/s Ethernet-style LAN port. The decision to incorporate networking ports instead of the usual I/O blocks, says Dace, was a calculated gamble. "When we started, Ethernet interface chips were not ready," and without these, ICL's strategy would collapse.

As the design progressed, ICL actively promoted standardization efforts for an Ethernet-style network. Today, interface chips are on the market and Ethernet is an internationally accepted standard supported by some 60 information-technology firms. *–Kevin Smith*

FIBER OPTICS

PHILIPS GIVES BOOST TO PERFORMANCE OF MULTIMODE FIBER

Aachen, West Germany

In the growing market for fiber-optic communications systems, the use of graded-index, or multimode, glass fiber as a communications medium has been surpassed by monomode fiber because of its superior performance characteristics. Now researchers at the Philips Research Laboratories here have given multimode fibers a new lease on life by

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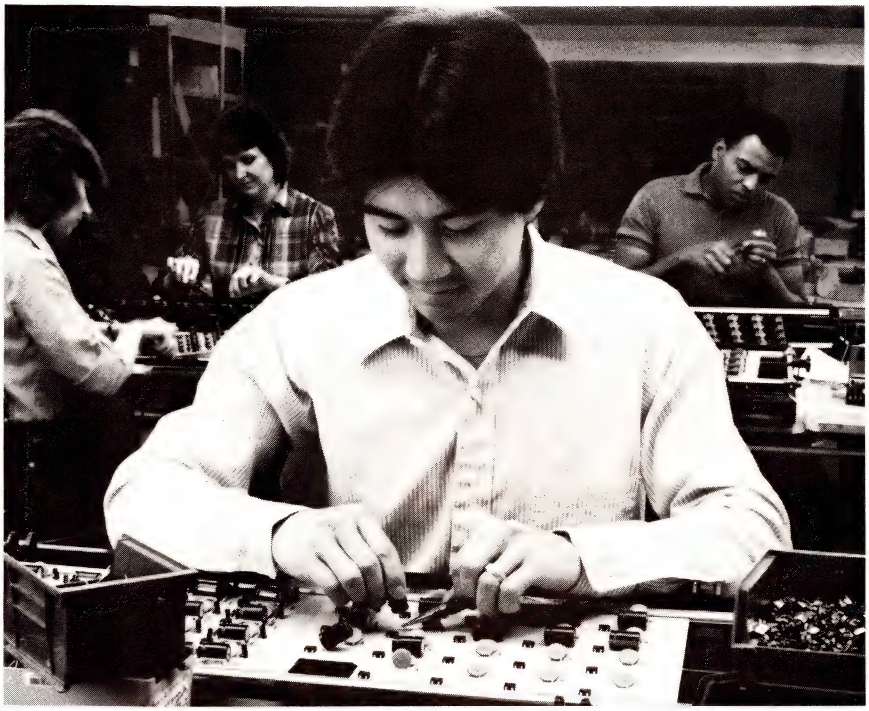

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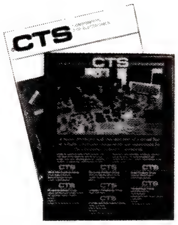

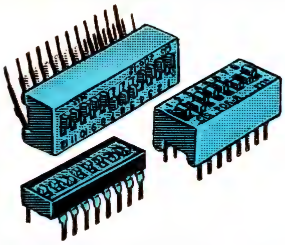

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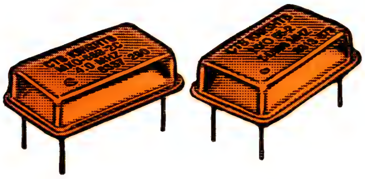

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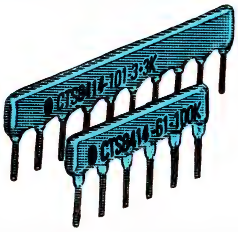

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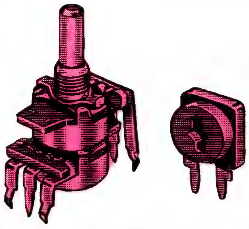

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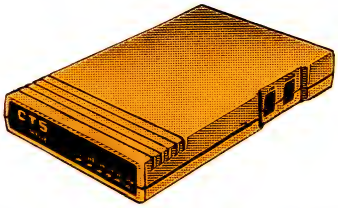

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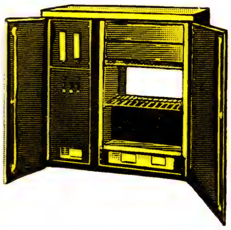

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showing that they can be used for data transmissions at higher speeds—565 Mb/s—and for longer distances—more than 37 km—over repeaterless links.

Up to now, only monomode fibers could handle 565-Mb/s optical communications over comparable distances without amplifying repeaters. And, as the experts see it, monomode transmissions will soon bridge distances of 50 km and, eventually, 100 km without amplification. Little wonder, then, that multimode fibers have been given little chance of survival in high-speed optical-communication environments. Typically, they transmit signals at rates up to 140 Mb/s and require a repeater every 18 km or thereabouts. As a result, many optical-cable vendors are emphasizing the higher-performance monomode fiber.

The key to the performance jump in graded-index fibers achieved by the Philips researchers is plasma-activated chemical-vapor-deposition (PCVD) fabrication, optimized to obtain a near-perfect refractive index profile. First proposed and shown to be practical by Hans Lydtin, Peter Geittner, and Dieter Küppers of the Aachen labs in 1973, the basic PCVD process has since evolved into an accepted technique for fiber preparation.

Along with the graded-index fiber's performance leap come several other advantages over its monomode counterpart, says Lydtin, head of the 20-person Fiber Optics Group here. Because of its relatively large core diameter—typically 50 μm—the light from a laser or light-emitting diode can easily be coupled into the fiber. That means less expensive light sources and detectors can be used, compared to those required for monomode fibers with their 10-μm cores. In addition, the graded-index fiber's large core means that splicing such fiber is relatively simple and can be done with less expensive connectors than are needed for monomode fibers.

Unlike monomode types, graded-index fibers can be operated not only in the 1,300-nm window but also in the 850-nm window. This means that in short-haul local-area applications, the 850-nm window could be used for narrowband communications and the 1,300-nm window for wideband uses.

Exceeds needs. The new Philips fiber far exceeds the specifications set by the West German post office for Bigfern, a nationwide optical communications network now being installed. The Bigfern specs call for a 1.2 GHz-km bandwidth, an attenuation of less than 0.6 dB/km, and a total systems bandwidth of 140 MHz over an 18-km link.

To meet the bandwidth requirements with a graded-index fiber, its refractive index profile must be as smooth as possible. It should have no pronounced steps, for these would limit the bandwidth. In numerical terms, the deviations from a perfect profile should be less than 1% of the maximum value of 1.5×10^{-2} over the whole length of the fiber, explains Geittner, a scientist in Lydtin's group.

Process makes it possible. A prerequisite for meeting these tough standards is the use of the PCVD process. With it, says Geittner, up to 2,000 layers of doped silicon dioxide can be deposited one atop the next in the fabrication process, which is not possible with most competing processes. The more layers deposited, the smoother the refractive index profile.

The PCVD process alone is not enough, however. Also necessary are eliminating the profile's central dip as well as having a rotationally symmetrical profile. Typically, in glass-fiber fabrication, the doping material evaporates from the innermost layers when the quartz tube is transformed into a solid rod from which the fiber is drawn. This evaporation of the dopant leads to a sharp dip in the refractive index profile which, in turn, limits the bandwidth. The Philips researchers have eliminated this dip by etching away the innermost SiO_2 layers during the rod-forming process.

Another bandwidth-limiting factor is rotational asymmetry of the profile, or irregularities of the refractive index. Such deviations are generally due to an uneven temperature distribution during the deposition of the doped SiO_2 layers. The Philips researchers got around this problem by precise temperature control and by turning the rod back and forth around its axis in the oven to ensure even temperature distribution and hence rotational symmetry of the refractive index profile.

The multimode fibers are used in a 60-fiber optical cable produced by Philips Kommunikations Industrie AG in Cologne and Tekade in Nuremberg, both subsidiaries of the Dutch electronics giant. The cable transmits at 678 megabaud—equivalent to 7,860 telephone channels—without amplification over a distance of 37.06 km.

Under practical conditions—that is, considering the attenuation reserves stipulated for communication networks by the postal authorities—a 565-Mb/s system achieves repeater distances up to 24 km. At a center point of 1,317 nm, it operates with an error rate of only 10^{-12}. The signal attenuation is 0.55 dB/km, not taking the splices into account. *–John Gosch*

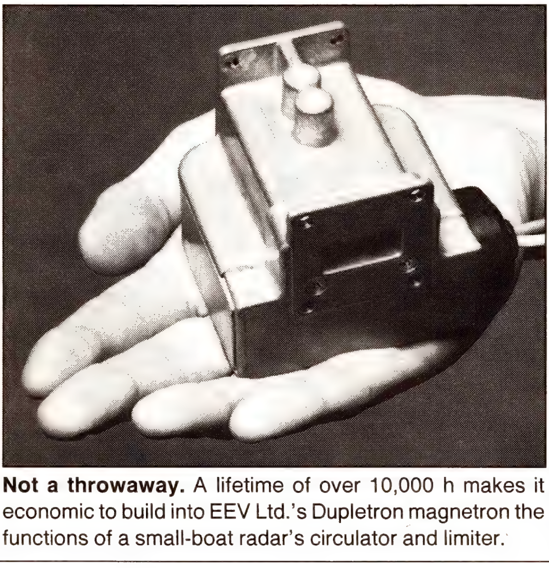
MICROWAVE

ENHANCED MAGNETRON CUTS COST OF RADAR

Chelmsford, England

Britain's English Electric Valve Co. expects to make a big splash in the marine radar world with its latest microwave device for small-boat radars. The Dupletron, as it is called, combines the functions of three microwave devices in a single unit that is one third the size of the separate components.

In most small-boat radars, the transmitter and receiver share a single antenna, and a device called a circulator separates transmit and receive paths. The circulator directs magnetron power to the antenna and also switches returned pulses to the receiver port. A signal limiter at the port protects the receiver from overloads and out-of-band signals.


Not a throwaway. A lifetime of over 10,000 h makes it economic to build into EEV Ltd.'s Dupletron magnetron the functions of a small-boat radar's circulator and limiter.

The Dupletron replaces the magnetron, circulator, and limiter found in conventional systems. It offers better performance than the separate elements, which are often made by different companies and seldom well matched. Moreover, it is cheaper, a vital factor in this cutthroat market, where radars sell for around $2,000 to $6,000. The company says that total savings range from 10% to 40%, partly from reduced component cost and partly because of lower testing and assembly costs.

The Dupletron is based on EEV's long-life magnetron, launched in 1982. Its operational life of 10,000 to 15,000 h means that boat owners do not usually need to replace the magnetron tube in their radars, as they often did in the past. EEV's "third-generation" magnetron was an immediate success and scooped up 45% share of the world market, the company says. Production is now running at 20,000 units a year. EEV's marketing manager David Taylor says, "Fourteen of the 18 largest radar manufacturers in the world now regularly buy EEV magnetrons, including four in Japan," which is home turf for Toshiba and other competitors.

With the magnetron no longer a throwaway item, all the microwave plumbing for transmit and receive functions could be built into a single high-value component, explains Taylor. The Dupletron's magnetron has the same advantages of long life, high efficiency, light weight, and low stray magnetic field. The anode structure, however, has been modified so that spurious radiation is generated at a controlled and predictable frequency matched to the bandwidth of the following p-i-n-diode limiter circuit. The out-of-band signals are often generated in poor operating conditions—when the antenna ices up, for example—and can burn out the receiver.

New structure. But the Dupletron's real innovation is a T-junction structure, with a p-i-n diode in the receiver port in place of a three-port limiter. When the diode is biased on, it appears as a short circuit to microwave energy entering the receiver port and reflects it to protect the receiver from burnout. The p-i-n diode is positioned so that the reflected energy reinforces the power launched in the direction of the antenna.

A toroidal transformer wound around the magnetron output senses the charging current before each radio-frequency pulse, so the p-i-n diode is always prebiased into blocking mode. Between pulses, the rf signal returned to the antenna passes to the receiver port with very little insertion loss. The limiter comprises a resonant microwave circuit (incorporating a second p-i-n diode) tuned to protect the receiver from out-of-band signals generated by the magnetron.

The Dupletron is tested as a complete device in both transmit and receive modes, so residual leakage of rf energy from the magnetron to the receiver port can be checked. This ensures that leakage is always within the safety limits of the highly vulnerable low-noise MOS FETs commonly found in the first stages of receiver amplifiers. The company's first Dupletrons operate in the X-band with peak power levels at 4, 7, and 11 kW. *–Kevin Smith*

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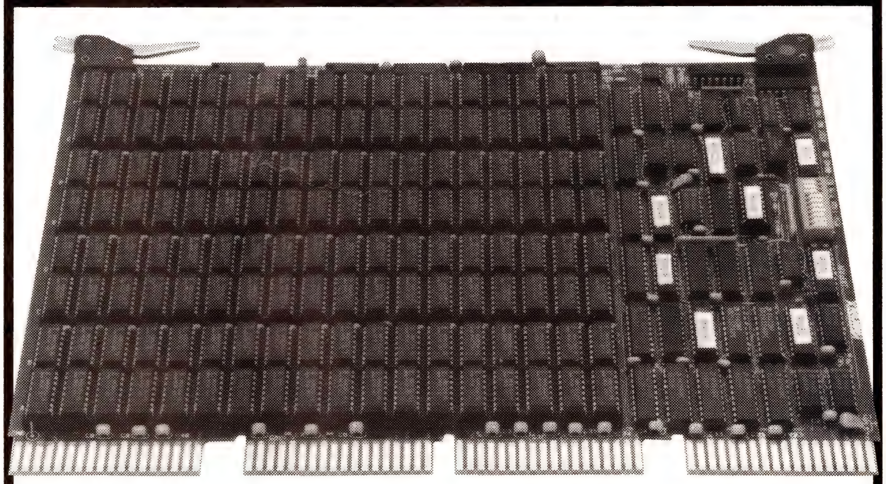

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GROWING MARKET FOR PROGRAMMABLE CONTROLLERS HINGES ON SOFTWARE

by David M. Weber

AS INTEGRATED NETWORKS CONTINUE TO GAIN IN FUNCTIONALITY, THEY FIND SPOTS IN MANY INDUSTRIES, INCLUDING ELECTRONICS

New York

Programmable controllers are becoming smaller, more powerful, and more flexible. As their prices drop, they increase their penetration into every level of the factory hierarchy—even cutting into areas once dominated by the minicomputer. Sales are growing at about 70% annually and are expected to pass the billion-dollar mark by 1988, but low-priced controllers will make up the bulk of this market. Indeed, as in other areas of information processing, the most profitable areas for growth will not be in hardware at all but in software and systems integration.

Illustrating this trend is Allen-Bradley Co., Milwaukee, one of the biggest names in programmable-controller hardware. In an agreement that portends a major step away from a focus solely on hardware, Allen-Bradley's Industrial Computer Group (which was the Systems Division before Allen-Bradley's takeover by Rockwell International Corp. early this year) will begin to sell industrial computer products manufactured by IBM Corp.'s Manufacturing Systems Products Division through the Allen-Bradley distribution network. The agreement was announced at the International Programmable Controller Conference in Detroit, where three industrial computer products designed jointly by IBM and Allen-Bradley were introduced as the first to be marketed under the pact.

Stress is on software. The product representing the biggest departure from Allen-Bradley's traditional orientation is the 6120 Industrial Computer System, which is an IBM Personal Computer modified with 3½-in. microdisks and hardened for the factory environment. "The 6120 is essentially no different from any personal computer you would find in an office," says Rob A. Spademan, Allen-Bradley's manager for commercial services. "It's compatible with most application programs that run under the MS-DOS operating system; you could even do word processing on it."

Though the 6120 is in most respects the same as the Workmaster, which General Electric Corp. introduced almost a year ago [*Electronics,* June 14, 1984, p. 48], the significant fact is that a new arena for competition has opened up for the companies involved in factory automation. Allen-Bradley's participation in an area that will be driven primarily by new developments in software merely adds momentum to a trend that will almost certainly grow to encompass the plans of other manufacturers as well as software houses.

John A. Blaeser, executive vice president of Gould Inc.'s Industrial Automation Section, concurs. "Obviously, the computer is the most visible element and frequently receives the most attention. In practice, however, it is the ability to supply and balance computers with communication and control that makes factory automation work for the specific needs of a single customer."

Because Gould is a minicomputer manufacturer in its own right, it seeks primarily to supply its own software for industrial process control. But an automated factory built around a high-speed—and potentially expensive—minicomputer will necessarily be configured differently from one in which computing power is more distributed.

Gould claims not to have overlooked this dichotomy. It made provisions for programming its mid-level model 884 programmable controller with an IBM PC and is developing the capability to interface its products with in-house voice and graphic-display technologies as well as ones supplied by outside vendors. Like most large industrial manufacturers, Gould is participating in MAP, the Manufacturing Automation Protocol instigated by General Motors Corp. but rapidly becoming the de facto communication and networking standard for factory automation [*ElectronicsWeek,* Dec. 17, 1984, p. 20].

Gould's main efforts, however, "will continue to be focused on being a single vendor for automation equipment," says Michael S. Bernath, who is president and general manager of the Programmable Control Division. "As the role of the programmable controller expands, successful companies must cope with both control functions and information management."

Split control. Central to Gould's strategy is the notion that it is better to split the control of manufacturing processing among several small programmable controllers than it is to build a few very large ones. "Implicit in that decision is that programmable controllers be able to communicate with each other, which requires the right data protocols," explains Bernath.

Honeywell Inc., a company known

Expandable. Programmable controllers, such as Gould Inc.'s, can work alone or be connected to other controllers over a data bus.

more for its computer line than for programmable controllers, has taken a tack similar to Gould's with its decision to participate in MAP. But it also seems to be stressing the operation of its controllers independent from any direct computer interface. With the introduction later this month of what Honeywell's Industrial Process Control Division calls the UDC 5000 (for universal digital controller), the computer giant hopes to break into a wide range of industries.

"By using the name 'universal,' we know that we're going to have a lot to live up to," says Carl Garcia, manager for sales development at Honeywell IPC. "But the UDC is fully compatible with most standard sensors, transmitters, and final control devices."

In Garcia's view, the most important thing to keep in mind when automating existing factories is that the changeover from old to new equipment doesn't happen all at once. "Controllers are usually replaced one at a time, and the most effective way into factories of our potential customers is a simple, rugged product with a lot of applications." Prominent among them are process industries like petroleum refineries and electric-power plants, but lately the electronics industry is finding increasing use for programmable controllers.

One does not have to look to the relatively exotic fields of wafer fabrication and surface mounting to find uses for programmable controllers, says Garcia. Even something as mundane as temperature control can be handled better by programmable controllers than by simple thermocouples.

For example, some applications in electronics manufacturing require that one temperature be controlled relative to another that may vary. With such relative control, however, the electrical parameters along a single conductor can change as the conductor heats up and cools unpredictably. Honeywell believes that the same UDC used by the petrochemical industry to control flow rates can be used economically in virtually all aspects of the electronics industry. In this case, it is simply a matter of reprogramming it to take a variable temperature into account when measuring voltage, current, or resistance.

Slow integration. Garcia points out that in most factories every operation is neither fully automated nor integrated into a computerized production scheme. Thus a stand-alone programmable controller, which can be programmed on site with a few membrane switches on the front panel, may have more immediate applications in existing factories than an elaborate set up for computer-integrated manufacturing. "But once Honeywell has its foot in the door with a simple, versatile controller, our customers will know where to turn when they're ready for a supervisory computer," he says.

Top-down programming. Indeed, for newer factories involved in large-scale manufacturing, Honeywell's five-level automation hierarchy allows one or a series of controllers to be programmed from the top down with a Honeywell minicomputer such as the DPS-6. Also, MAP protocols permit stand-alone controllers, linked to a work cell's host computer in a local-area network, to become integrated in a broadband LAN to receive instructions downloaded directly from the factory's main computer. But for now, most customers are interested in automating one operation at a time.

Software driven. Allen-Bradley's factory-hardened IBM PC opens the programmable-controller market to software developers.

Universal. Honeywell's UDC 5000 is designed to work in many industries. One application is controlling thermal processes.

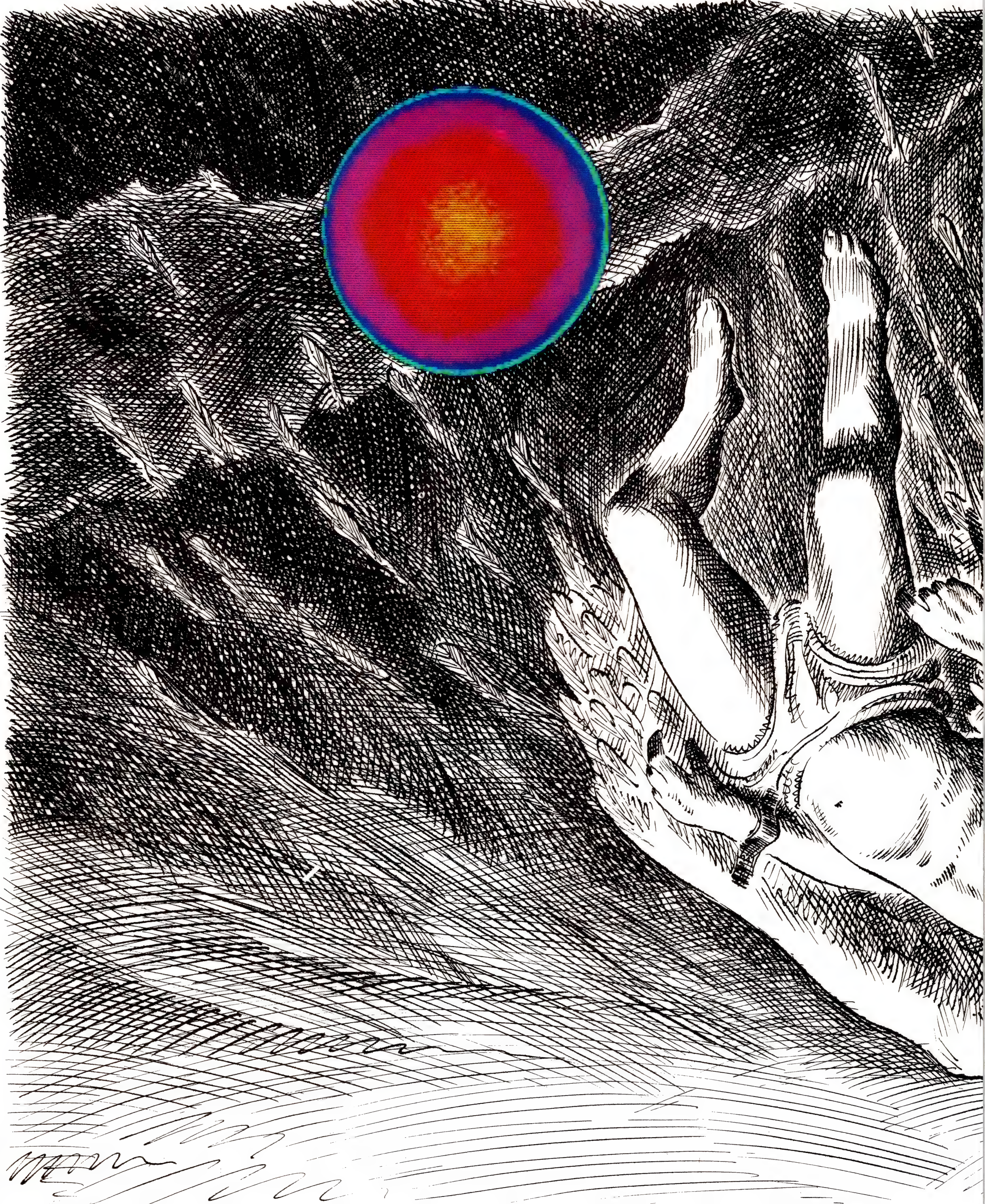
Walt Castro, Allen-Bradley senior vice president, envisions a time when a factory's programmable controllers are all connected by a single networking protocol (MAP-compatible Vistanet in the Allen-Bradley scheme). For programming on the work-cell level, however, Castro looks to IBM in the same way a middle-level executive might in buying a personal computer for a secretary.

"A hardened IBM PC in a machining operation complements the automation products we already offer," says Castro. "IBM's position in the market will add another dimension to our ability to integrate our controllers into an automated factory." Further, if past experience is a reliable indicator, there will be no shortage of enterprising individuals to write programs for IBM's industrial PCs.

One such program, called the Modelmaster, was developed by GE for its Workmaster factory personal computer and is marketed by the company's Automation Controls Department in Charlottesville, Va. Although it is primarily a program for simulating material flow throughout an entire factory, Modelmaster can also be used to represent the different configurations of a work cell, depending on what kind of programmable controllers the system uses. Screen icons represent the controllers, which can be moved around with a joystick.

The controllers' operating parameters can be numerically entered into the Modelmaster program and altered with changes in work-cell configuration. The ability to simulate the functionalities of different programmable controllers before they are actually employed is considered vital to the eventual computerized integration of manufacturing. ☐

There's more to the picture tha



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Now to the question of whether Icarus would have taken off if he had known the actual temperature of the sun. Perhaps he might have stayed on terra firma – but there's no guarantee, because flyers have always been a breed apart. If he hadn't flown though, the world would story poorer. So, it was probably all for the best.

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U.S. SEMICONDUCTOR FIRMS STEP UP PACE OF DEALS WITH JAPANESE

by Larry Waller

HARSH REALITIES OF THE MARKETPLACE ARE FORCING COMPLEX, PRAGMATIC EXCHANGES BETWEEN RIVALS

Los Angeles

Lost in the blitz of blandly announced deals between U.S. and Japanese semiconductor houses during the past year is that what has been negotiated is anything but ordinary. In fact, many of the alliances are staking out objectives that are far beyond the simple exchange of device technology or second-sourcing of parts.

By any standard, the cumulative effect of so many agreements among semiconductor players from both countries must be a riveting topic inside the executive suites of U.S. firms. But public comment about the deals, especially on their overall significance, is scarce.

One reason is that it is too soon to tell with any certainty whether such agreements will work—especially in view of the spotty record of contracts between U.S. semiconductor firms, where egos and conflicting economic interests prove to be nearly insurmountable barriers.

A more basic reason keeps U.S. companies from airing their strategic thoughts, say industry analysts: it is difficult to justify agreements with the Japanese while decrying the competitive advantage of their industries and calling for changes.

Several U.S. companies find themselves in that ticklish situation, says William J. McClean, manager of market research for industry consultant Integrated Circuit Engineering Corp. "They have to swallow their pride and go to the Japanese for help in many cases."

Playing to the bottom line. One such agreement, often cited as an example for its potential significance, is the long-term comprehensive pact between Motorola Inc. and Hitachi Ltd. [*ElectronicsWeek,* Jan. 14, 1985, p. 9]. In Motorola's case, it could be doubly hard to reconcile close ties to Hitachi when the U.S. firm's top officials are calling for a 20% surcharge on imported goods—particularly on Japanese cellular communications gear that Motorola claims has an unfair price advantage in the U.S.

"Their attitude is, 'If it helps the bottom line, then playing kissy-face with Hitachi doesn't make any difference,' " says McClean. Motorola will not discuss the issue of its Hitachi deal as it relates to Japanese trade.

Less reticent to put the matter into perspective is Robert N. Noyce, vice chairman of Intel Corp. and a frequent spokesman for the Semiconductor Industry Association on problems of trading with the Japanese. Noyce singles out pragmatic considerations as the principal impetus for making private deals. He cites "our pervasive technology, which they will go into one way or another. We might as well do it on the up and up. Otherwise, there would be a lot of legal battles."

Other benefits for U.S. firms can also ensue, as enumerated by Integrated Circuit Engineering's "Status 1985" report on the IC industry. "Collaboration is an effective solution to a multitude of problems, particularly related to acquisition of process technology and product marketing," it says. Heading the list is penetration of the "difficult-to-reach Japanese marketplace" by U.S. products, by getting an initial foothold. In general, the report saw 1984 technology agreements as dealing mostly with nonstandard parts, "trading designs and patent rights for wafer capacity or process technology."

Financial edge. One advantage that U.S.-Japanese deals could offer might come in the critical financial arena, in the view of Gilbert Amelio, president of Rockwell International Corp.'s Semiconductor Products Division. Amelio, an

RECENT U.S. & JAPAN SEMICONDUCTOR AGREEMENTS

Companies	Date	Technology exchanged
RCA Corp. – Sharp Corp.	April 1985	Share CMOS design and process technology
Intel Corp. – Toshiba Corp.	Jan. 1985	Toshiba is manufacturing and marketing Intel interference controller chips
Motorola Inc. – Hitachi Ltd.	Jan. 1985	Motorola will second-source Hitachi's 6301 microcomputer
Intel – Fujitsu Ltd.	Nov. 1984	Fujitsu will manufacture Intel's 80186 and 80286 microprocessors and the 8051 controller chip
Intel – Fujitsu	Sept. 1984	Agreement includes Intel logic design and Fujitsu layout for a new 8/16-bit I/O processor known as the 8089-2
Motorola – Toko Electric Co.	July 1984	Subcontracted bipolar fabrication in Japan
Standard Microsystems Inc. – Oki Electric Industrial Co.	July 1984	Nonexclusive cross-licensing of each company's patents and patent applications
Monolithic Memories Inc. – Fujitsu	July 1984	Monolithic Memories will second-source Fujitsu's B-series bipolar TTL gate arrays
Intel – Oki	June 1984	Oki will provide CMOS versions of popular Intel products
American Microsystems Inc. – Hitachi	May 1984	AMI will second-source Hitachi's line of codec circuits
Motorola – Toshiba	April 1984	Toshiba will second-source Motorola's C-Quam AM stereo decoder IC
Zilog Inc. – NEC Ltd.	March 1984	Zilog will second-source NEC's proprietary V-series microprocessors and peripheral controllers

SOURCE: INTEGRATED CIRCUIT ENGINEERING CORP.

SIA board member, sees such alliances as a means to open access to Japanese capital markets. Because the lower cost of borrowing in Japan—about half of U.S. rates—constitutes an overwhelming edge for its semiconductor industry, he says, anything closing the gap is positive. "The only way is to have a relationship with a Japanese company." No such deals have surfaced, however.

Recognition of a need for help in innovation could be the driving factor in the proliferation of deals between firms in both countries, says the U.S. head of a major Japanese company. "This is especially apparent in the computer industry, where technology is constantly being upgraded at a fast pace and, consequently, product life cycles are extremely short," says John Rehfeld, vice president and general manager of Toshiba Corp.'s Information Systems Division. "The Japanese computer and electronics industry until now has suffered from a lack of innovation and inability to quickly introduce new technology and new products as the market demands."

Instead, Japanese firms concentrate on such strengths as marketing products with relatively long life cycles and improving their functions and reliability. Bringing together the specialties of both sides therefore means that "opportunities for doing business with the Japanese are greater today than they ever have been," he adds. Rehfeld often speaks on U.S.-Japanese trade topics, offering these remarks to the World Trade Center Association of Orange County, Calif.

Though most industry hands agree that U.S. semiconductor firms can use help in areas where the Japanese have forged ahead—CMOS design in circuits and, most of all, process technology—skepticism abounds about lasting benefits from the current round of tie-ups. For one thing, the U.S. historically has set the pace in innovative product design, with Japan successfully playing catch-up by copying the products and building them cheaply.

One recent agreement that underlines potential payoffs to both parties surfaced in January between Toshiba and Intel. Through Toshiba America Inc., the Japanese firm will offer CMOS interface controller chips for connecting the bus of Intel's advanced Multibus II system with its single-board computers.

Simple motive. From Intel's point of view, the motivation for this deal was simple, notes Gary Adams, general manager of the Multibus II operation: "We need a technology, CMOS gate arrays, that Intel doesn't possess." Toshiba was chosen as a company with quality manufacturing in this technology. Furthermore, it was put together by respective general managers based in the U.S. "No directives came down from corporate," says Adams.

For Toshiba, the agreement "allows us to participate in a new market," explains J. Litus Jr. It makes sense in business terms and could lead to more alliances, he says. Toshiba already serves as a second source for Intel's n-MOS 8085 processor family as well as for several single-chip controllers in both n-MOS and CMOS.

Besides supplying Intel, Toshiba plans in this quarter to begin marketing two chips: the 84-pin bus arbiter/controller and 68-pin message-interrupt controller.

It follows that any trend that gives Asian competitors quicker access to new products will make any U.S. advantage in innovation disappear even faster. "In the long term, it could be disastrous," McClean states. "You're selling them the bullet to shoot you later."

Economic war. The chief executive of one semiconductor firm that does much business in Japan and which consequently he asks to remain unnamed, also denounces these deals in the strongest terms. "It's another example of our short-term thinking versus their long-term planning that hurts us so badly. Most people don't want to face the facts: we're in an economic war with Japan." He explains that there is an easy way to tell how the deals are working. "When they're to the advantage of the Japanese, things go along smoothly. Otherwise, if the U.S. company is getting some good from it, all of a sudden bad things start to happen, and the deal is off." In his view, this round of deals is "totally orchestrated by MITI."

Some U.S. firms have held back from any deals despite the opportunity. "Our position is that we don't intend to sell our technology to Japan," says George Scalise, senior vice president of Advanced Micro Devices Inc. "We are prepared to negotiate a technology swap, where we can get what we consider to be equivalent value. We have looked into these but haven't found any."

Speculation about what motivates Japanese participation on such a wide scale, beyond profit goals, usually centers on the Ministry of International Trade and Industry. But this powerful agency, which must sanction any foreign agreement, vows it plays a passive role.

In fact, the MITI considers semiconductors a mature industry not demanding of its time—which is divided between nourishing infant fields and easing the death of declining businesses, says Joshihiko Sumi, deputy director of the MITI's Industrial Electronics Division. Agreements between Japanese and foreign semiconductor firms are filed with the MITI under foreign-exchange laws, and Sumi notes that many of these are not announced publicly. ☐

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MOLECULAR ELECTRONICS RESEARCH GROWING DESPITE CONTROVERSY

by Michael Rand

PROPONENTS OF ORGANIC MECHANISMS SEE BREAKTHROUGHS IN A VARIETY OF APPLICATIONS, BUT SKEPTICS CRY 'HYPE'

New York

Faced with the ultimate limit of technologies that use inorganic structures such as silicon and germanium, semiconductor researchers are exploring the possibility of performing electronic functions using mechanisms inherent in organic substances. Now more widely known as molecular electronics, the field is attracting attention from academic and government scientists, and with it, its share of controversy.

To its proponents, the new field heralds superfast, superdense computers beyond the capability of any silicon-based machines. But the more conservative tend to think that talk about "biochips" is unrealistic hype.

Nevertheless, this multidisciplinary field appears to have potential for the development of everything from versatile chemical sensors to extremely dense data storage. Work now being done in optical storage technology and two-terminal switching devices using organic compounds and molecular electronics is rapidly approaching the point of commercial exploitation.

According to a recent study by Gorham International, a private research and technology assessment group in Maine, the number of workers engaged in the field of molecular electronics has increased by an order of magnitude over the last five years, and research funding, currently about $100 million a year, could reach $1 billion by 1990.

The research goes by various names: molecular electronics, chemical-based computing, biochips, biosensors, or nanoelectronics. Biochips, a term most serious researchers in molecular electronics scorn, refers to functional parts constructed using biological or organic materials and processes.

Rather than using simple crystals of silicon, germanium, or gallium arsenide, the chips would be made from molecules of organic compounds. Some suggested advantages include potentially increased density, increased yield, ease of fabrication, low cost, and immunity to radiation and electromagnetic pulse.

If true, those advantages could correct many well-known problems with digital computers—namely, heat production, fault intolerance, and the slowness with which von Neumann machines handle some computations. In addition, based on current semiconductor fabrication processes and technology, feature sizes of components on chips appear to be approaching a limit around 0.4 μm, suggesting that chip density is approaching a limit, somewhere around 1 million transistors per chip.

With higher densities and the proximity of wires, problems such as crosstalk, tunneling, heat dissipation, and capacitive coupling occur and degrade function. Biochips will approach that "silicon wall" in 5 to 10 years, according to James McAlear, president of Gentronix Labs Inc., Rockville, Md.

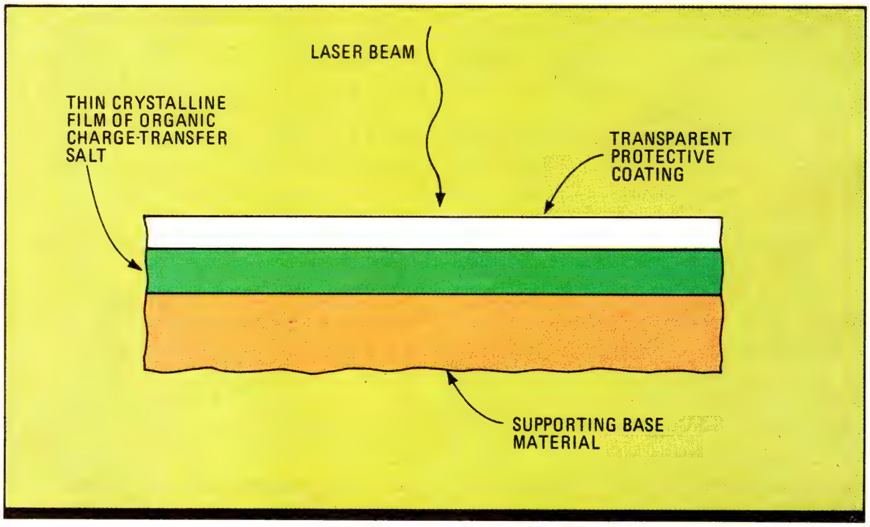
New and improved. McAlear, the recipient of numerous grants to study novel biochemical approaches to microelectronics, pioneered the idea of using organized protein molecules to design a computer. He sees a coming need for a new technology to increase densities, speed, ease of fabrication, and computing power in the fields of communications, pattern recognition, artificial intelligence, parallel processing, radar imaging, and defense.

At Johns Hopkins University's Applied Physics Lab, in Laurel, Md., chemist Richard S. Potember and his team of researchers are using synthesized organic structures to develop an erasable optical disk (see figure below).

Laser as a source. In conventional optical-storage systems, a major limitation is that the disks are not erasable. Potember has demonstrated that a carbon dioxide laser beam—or any laser, for that matter—can be used as a source to reverse or erase switched regions of an organic film.

The film-based disk is made of an organometallic semiconductor—tetracyanoquinodimethane (TCNQ), an organic charge-transfer complex or salt. A salt consists of a metallic donor and an organic accepter sharing an ionic bond, an example being sodium chloride—common table salt.

This means that the complex can change its state by transferring electrons from one bond to another. Optical information processing is carried out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employ a dissipative bank of power transistors or vacuum tubes, the "series pass element," which are installed between a rectified-filtered source of "raw d-c" and the output. Feedback from the output, and control signals, modify the conductance of the series pass element, stabilizing and/or modifying the output. Kepco linear power supplies, except for two series offered to the OEM, are intended for use on the laboratory bench, or in automatic test systems.

The advantages of Kepco linear supplies are:

— They offer high gain for "tight regulation" and high accuracy control, including the ability to interface with the IEEE bus.

— They function with negligible radiated or conducted EMI.

— They provide such facilities as current stabilization and operational amplifier-like control.

Their disadvantages are that they are less efficient than switching and ferroresonant power supplies with similar power ratings, and much larger and heavier than switchers.

FERRORESONANT POWER SUPPLIES'

stabilizing principle is based upon the saturation of a portion of a transformer's iron by use of a resonating capacitor, so that the output becomes a square waveform of a constant amplitude related to the magnetic structure.

The advantages of Kepco ferroresonant power supplies are:

— They are extremely simple, rugged, and reliable, and are thus suitable for heavy duty industrial service.

— They are very efficient (65-70%).

— They offer considerable isolation from mains noise and are virtually indifferent to any outside interference.

— With respect to their power, stability, and reliability, they are quite low-priced.

Their disadvantages are that they are rather large and heavy, and their output is fixed and cannot be adjusted (except by taps).

SWITCHING POWER SUPPLIES

are based upon the conversion of an a-c input into d-c, and chopping the d-c with high frequency square pulses. The pulses are re-rectified, to produce the d-c output. Modifying the width of the pulses allows a measure of control over the voltage.

The advantages of Kepco switching power supplies are:

— They are the smallest and lightest of the three types of power supplies, because transformers operating at high frequencies can be much smaller and lighter than transformers operating at 50/60 Hz.

— They are the most efficient (65-85%).

— They can function with a wide choice of source voltages, including d-c.

— They store sufficient energy to bridge short power outages.

A basic disadvantage of most switching power supplies is that they require shielding and filtering to control EMI generated by the switching process. Most Kepco switchers have such filters built in, and the covers which are standard on some, and optionally available for most others, provide substantial shielding.

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BOP: Bipolar operational power supplies. Operate in all four quadrants — positive or negative source, positive or negative sink — bounded by four independently adjustable, programmable limits. Full, programmable control over both voltage and current, with mode selector. Separate channels are activated for each mode. Bandwidths up to 4.5 kHz. Can be controlled either directly through front panel 10-turn bipolar controls, or remotely. Digital control through optional internal plug-in interface, or Kepco SN or TLD digital programmer*. 100-, 200-, and 400-Watt models available.

**Available fourth quarter, 1985*

BOP-HV: High voltage (±500V and ±1000V) bipolar operational power supplies. Four quadrant operation, with independently adjustable, programmable limits. Full, programmable control over both voltage and current (from −100% to +100% of their range), with mode selector. Separate voltage and current channels. Direct front panel or remote control. Digital control through Kepco SN digital programmer. Both models 80 Watts.

CC/PCX-MAT: Plug-in, 1/6 rack width stabilizers for current (Series CC) and voltage (Series PCX-MAT). Output controlled from front panel multi-turn controls or by remote analog or digital control. Digital control through Kepco SN digital programmers. Six PCX-MAT models, outputs 7V to 100V d-c. All 14 to 20 Watts.

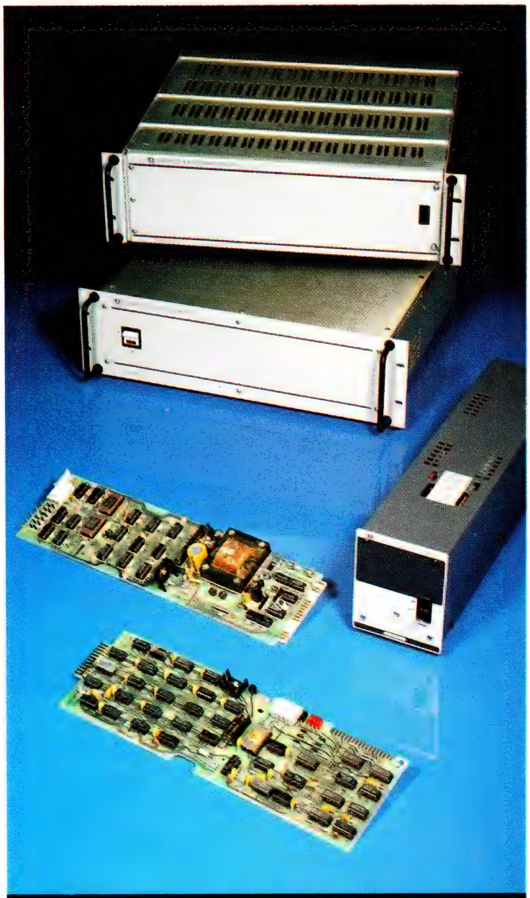
JQE: Systems-type voltage stabilizers with rectangular current limiting. Direct front-panel or remote control. Digital control of voltage through Kepco SN digital programmers. 31 models, 100, 250, 500, 1000 Watts, 0-6V to 0-150V d-c output.

MPS 620M: Triple output 70-Watt bench supply intended for the IC/μP experimenter. Has one 0 to 6V/0 to 5A d-c output with current limiting and overvoltage protection, continuously adjustable with a 10-turn front panel control, for digital circuits; and two tracked outputs: 0 to +20V and 0 to −20V, each rated at 0-1A, which can be used in series for 40V.

NTC: Low power (2-Watt) shunt stabilized operational inverting amplifier, intended principally as an interface between an active programming signal and a higher powered, operationally programmable power supply, to allow for control with the power supply's negative output terminal common, or grounded.

OPS IXB/OPS X: High voltage (0-500V, 0-1000V, 0-2000V, 0-3500V, and 0-5000V) voltage/current stabilizers. When used with a resistive load, they are fast-programmable. Can be controlled through their entire rated range by a 0-1mA control current, either externally generated or derived from a built-in uncommitted amplifier connected to the input summing terminal. The 500V and 1000V models can be digitally controlled through Kepco SN digital programmer.

PRR: 1000-Watt fixed output rack mounted or systems ferroresonant voltage stabilizers. Low-cost, reliable. Efficiency 70-80%. Superb line isolation. Low ripple, no spikes. Inherent current limiting and overvoltage protection. Four models: 12V/0-77A, 24V/0-42A, 28V/0-36A, 48V/0-22A d-c outputs.



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TLD 488-16: Interactive programmer: commands, and reacts to as many as 16 Kepco ATE and/or BOP* power supplies at once. Communicates with system controller in CIIL (a subset of ATLAS Programming Language), through IEEE 488 bus.

**BOP card available fourth quarter, 1985*

BIT-488: Programming card designed to be built into Kepco BOP power supplies (optional), or subsequently field-installed. For use with IEEE 488 bus. BIT 500: Same, but for use with data buses using bit-parallel data transfer.

SN 488: Stand-alone single or dual channel programmer, for use with IEEE 488 bus.

SN 500: Same, but for use with data buses using bit-parallel data transfer.

SNR 488: Card-cage digital programming system. Can accommodate up to 8 dual channel program cards. For use with IEEE 488 bus.

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EFX: 50-, 100-, 150-, and 210-Watt high-quality, low cost open frame switchers, with four outputs which offer a variety of popular Volt/Ampere combinations. UL recognized, CSA certified, built-in EMI filter for FCC Class A requirements.

Output #1: all +5V; outputs #2 and #3: either ±12V or ±15V; output #4: either +24V or −5V. Optional enclosures available.

EMR: Triple-output 22-, 42-, and 54-Watt, and quadruple-output 53- and 80-Watt, fully enclosed and shielded power supplies. High quality and low price are due in part to computer-aided design, and to use of proprietary hybrid microcircuits which greatly reduce parts population. UL recognized, CSA certified, built-in EMI filter for FCC Class B requirements.

On all models, output #1 is +5V, output #2 is +12V, and output #3 is -12V; on the two models with a fourth output, it is +24V.

ERX: World Power™ single-output 30-, 60-, and 120-Watt open frame power supplies meeting highest international safety and EMI standards. Two custom hybrid microcircuits reduce parts population, increase reliability. All sizes available with a 5V, 12V, 15V, or 24V well stabilized, adjustable output, protected by a current limiter and over-voltage protector. UL recognized, CSA certified. SELV per IEC 380 and VDE 0806. Built-in EMI filter for FCC Class B requirements.

MRM: Multi-output 40-120 Watts, flyback and forward converters in PC card (frameless) and L-chassis style, designed to meet the logic, display, serial output, and disk drive needs of CRT terminals, microcomputers and video games. All units are UL recognized and CSA certified. "KV" models are TÜV certified SELV per IEC 380 and VDE 0806. Built-in filter for FCC Class B requirements.

MP/CMP: Single-output (MP) and dual-output (CMP) 10-Watt extra compact, high efficiency switching power supplies. d-c output range of MP: 5V to 15V and 2A to 0.8A. d-c output range of CMP: output #1, +12V to +15V and 0.4A to 0.5A; output #2, −5 to −12V and 0.4A to 0.5A.

RMT/RXT/RMK/RMX/RBX: Compact, highly efficient, fully enclosed and shielded a-c to d-c or d-c to d-c switching power supplies offering stabilized outputs, overvoltage and overcurrent protection, and remote on-off. On most models, output voltages are adjustable +10% to −30%.

Series RMT (30 and 70 Watts), and RXT (150 Watts) all provide three outputs, including a basic 5V logic output which is rated at 6.0 Amps in the 30 Watt models, 10 Amps in the 70 Watt models, and 20 Amps in the 150 Watt models.

Series RMK, RMX and RBX provide one output. Models are available with outputs with 2V, 5V, 9V, 12V, 15V, 24V, and 28V d-c, and a wide range of current ratings. (30Watts-600Watts) offering adjustable overvoltage and overcurrent protection and remote on-off. UL recognized, CSA certified.

RMD/RDT: Isolated, fully enclosed and shielded 30-, 50-, 70-, 125-, and 225-Watt d-c to d-c converters offering adjustable overvoltage and overcurrent protection, and remote on-off. In Series RMD, output voltages are adjustable +10% to −30%; in Series RDT, ±10% at all outputs. Standard inputs for Series RMD are 12V, 24V, 48V, and 110V; for Series RDT, 24V and 48V.

Series RMD provides one output and 5V, 9V, 12V, and 48V outputs are offered for all except the 110V models. For the 110V models, 15V and 24V outputs are offered.

Series RDT provides three outputs: a +5V principal output, a second output which can be either +12V or +15V, and a third which can be −12V or −15V. UL recognized, CSA certified.

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ATE: Voltage/current stabilizer with automatic crossover, and separate voltmeter and ammeter for continuous output monitoring. Can be controlled either directly through front panel 10-turn rheostats, or remotely by analog or digital signals. Digital control is by Kepco's SN or TLD digital programmers. User selectable slow or fast mode of operation — slow for delivering constant voltage, fast for constant current or responding to fast control inputs. Bandwidth in fast mode up to 53 kHz. 50-, 100-, 250-, 500-, 1000-Watt models available, including the new high-voltage 250-Watt Model ATE 325-0.8M which uses power FETs as the series pass element.

APH: High voltage (0-500V, 0-1000V, and 0-2000V) voltage/current stabilizer with automatic crossover. Separate voltmeter and ammeter. Direct front panel or remote control. Digital control of 500V and 1000V models through Kepco SN digital programmer. All models: 20 Watts.

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when the TCNQ film, or a derivative of this class of radical ion salts, is irradiated with a narrow laser light.

This changes the chemical state of the TCNQ, which is seen as a color change at each data point. The method of reading the spot or data point is the same well-known method used currently in optical-disk technology—that is, reading the difference in absorption or reflectivity between the written and the unwritten spot.

Actually, any fundamental optical technique can be used to measure this color contrast—representing a stored bit of information—because this contrast represents a change in absorption, transmission, and reflection of light.

To erase the spot or stored bit, a higher-powered laser is used essentially to heat the complex back to its original state by altering the positions of electrons on chemical bonds.

At present, the disk can be written on and erased 10 times, says Potember. The write time of the disk is 5 ns, which is 20 times faster than current optical recording speeds not yet commercially available, he says. The fabrication of the organometallic films uses the same semiconductor-type processing equipment currently used in the semiconductor industry.

A major chemical corporation this week has signed an agreement that includes a generous research grant and a share of the royalties when the disk is marketed. The contract will make chemical-based computing technology available for commercialization and put chemical-based computing on the electronics map.

Two terminals. Another promising molecular-electronic device from Potember's lab is a two-terminal chip made from the same TCNQ-type organometallic film as used in the disk (see figure). This chip is based on the electrical switching behavior exhibited by the organic films.

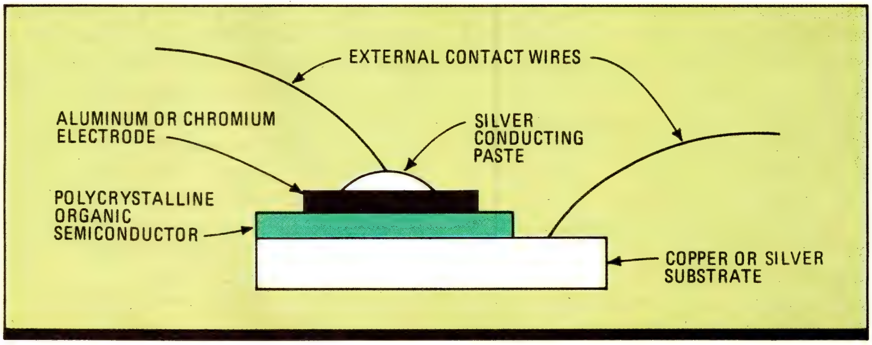
For electrical measurements, a top metal electrode of aluminum or chromium was evaporated or sputtered on the organic film, and contacts made to the electrode and substrate. Upon application of a voltage, the films of copper- or silver-TCNQ switch from high resistance ($10^6\ \Omega$) to low resistance ($10^2\ \Omega$) in less than 4 ns. The condition can be reversed by application of short current pulses or with laser light.

Researchers at the California Institute of Technology and the Jet Propulsion Laboratory in Pasadena, Calif., are interested as well in two-terminal chips for potential applications in associative memories.

Associative memories are content addressable rather than addressable by physical address. An application of associative memory is the cache-memory feature on various computers. In this case, the cache can store up to 4,000 random past instructions, thus eliminating instruction fetches and increasing cycle time.

Some researchers in the field of advanced neural systems believe that associative memories are basic to understanding the human memory scheme or advanced neural systems. Potember's device or element could serve as the active switch in the physical implementation of an associative memory. Currently, John Hopfield of Caltech and AT&T Bell Laboratories and co-researcher John Psaltis, also of Caltech, have implemented an associative memory as a two-dimensional matrix with light-emitting diodes at the nodes and an interconnection scheme with 4,000 connections.

Another area in which molecular electronics is beginning to pay off is in the area of biosensors. Classical biosensors are solid-state circuits made from enzymes, immunoproteins, or nucleic acid immobilized near a transducer. Genex Corp., a biotechnology company in Gaithersburg, Md., does have a chemical-based computing program left over from the days when it was owned by Bendix Corp. and was interested in protein engineering. In protein engineering, the structure and function of proteins are altered and engineered. Basically, Genex's program tries to make materials suitable for fabricating biosensors.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ALUMINUM OR CHROMIUM ELECTRODE
SILVER CONDUCTING PASTE
POLYCRYSTALLINE ORGANIC SEMICONDUCTOR
COPPER OR SILVER SUBSTRATE

Salt switch. A two-terminal device is made from a complex salt that is a polycrystalline semiconductor. The elements or devices are easy to make, have low power dissipation, and exhibit fast switching characteristics. One potential application is in associative memories.

Protein engineering. The firm is interested in protein engineering and biosensors because protein engineering and the sensing of specific chemicals is the basis for manufacturing some of their products. "Before there are any real strides in commercialization of all this futuristic technology, there must be considerable groundwork in the material science of proteins," says Kevin Ulmer, vice president of advanced research.

According to almost every one of the researchers that *ElectronicsWeek* contacted, the Japanese are ferociously pursing biomaterial and biosensor groundwork—which for some researchers is reason enough for the U.S. to get serious and spend some money in stepping up a more coordinated effort.

Japan's Ministry of International Trade and Industry has devised the basic development plan of bio-elements and made the plan a new theme for the Research and Development Project of Basic Technology for Future Industries. This plan seeks to develop the bio-element and aims to establish the basic technology of biocomputers. With about a $32 million investment, the MITI plans to do theoretical basic research for 10 years and achieve understanding by the joint efforts of government and industry with participation by electronics, electrical, and chemical firms.

Among the industrial firms interested in biomolecular elements are Nippon Electric, Hitachi, Matsushita Electric Industrial, Sharp, Sony, Omron Tateisi Electronics, Canon, Ajinomoto, Suntory, and Kureha Chemical Industry. Many other electronics and biotechnolgy-related firms are also reportedly interested in the field.

The fact that Japan's leading semiconductor manufacturer, NEC Corp., started serious research on biomolecular elements stimulated other firms to join the research and development competition. This will accelerate the trend. These firms expect the Electrotechnical Laboratory to receive a large appropriation for this new theme in the Research and Development Project of Basic Technology for Future Industries.

NEC says that up till now it has had no significant results in commercializing devices based on monomolecular technology, and company sources speculate that Canon and Matsushita are no further along the developmental curve. NEC, however, has developed a biosensor for the measurement of urea in a drop of blood, urine, or other fluid.

Thus, although the Japanese are not saying much, it is known that they are working with the Langmuir-Blodgett thin-film process that has proven very successful in the U.S. for laser-scanned devices. ☐

← Circle 42 on reader service card

PLAYERS

BRITAIN'S LOGICA SEEKS TO DIVERSIFY OPERATIONS

Successful software and consulting firm worries investors as it moves to increase its manufacturing operations

London

Sixteen years ago, Phillip Hughes and a few close associates left Scicon Consultancy International Ltd., a subsidiary of British Petroleum plc, to set up a rival software and systems outfit. That startup, Logica plc, now has revenues of $87.5 million—almost double that of Scicon's—and the 2,000-person company ranks as one of Europe's leading software and systems consultancies.

The firm is a regular consultant for European government agencies, postal and telecommunications authorities, and Fortune 500 companies. Among other things, Logica has developed systems software used by British banks to settle their daily interbank sterling payments; other Logica-developed software runs an integrated-manufacturing rubber plant for Dunlop Ltd. International computer companies such as IBM, Modcomp, and Perkin-Elmer use Logica to develop systems and applications software. And Logica's word processors, sold by UK computer giant International Computers Limited plc, have taken 25% of the UK market.

The company has sustained a growth rate of nearly 30% a year, which led it to go public in 1983. But by the second half of 1984, Logica was having growing pains. Though its sales of about $47 million still represented a growth rate of 25% over the previous year and its profits grew 18% (to about $2.68 million), observers say these figures could have been better.

Logica chalked up losses of almost $1 million in the U.S., a market that has turned out to be a graveyard for the dreams of many British companies. And Logica's latest hardware diversification—into networked office products—has gone off like a damp rocket, raising investor's doubts abouts whether the the firm's hardware will survive on the market.

Logica chairman Phillip Hughes insists that the cash drain of his firm's U.S. operation has now been staunched. He remains confident that the networked office products bed Polynet and Kennet) ed by Logica VTS, its office-automation subsidiary, will be successful.

Nonetheless, the value of Logica's shares on the London stock market has slipped from a high of 435 pence to 288 pence. The question investors here are asking is: is Logica headed for an unspectacular middle age?

The answer is probably not. Though a technology assay is harder to read than the firm's balance sheet, Logica still has formidable strengths. Chairman Hughes's goals for the firm are simple: he wants Logica to work at the forefront of technology and to be highly international, with a spread of interests that encompasses its consulting work, custom software systems, and products.

"One thing that makes us unique is the diversity of our business," notes Richard N. Berg, Logica's commercial director. "First and foremost, we are a systems company, and one aspect of that is consultancy. It gets us a lot of exposure at high levels." Logica's activities are widespread, ranging from a customer service system for British Telecom, to a computer system for the Hong Kong stock market, to a new North Atlantic Treaty Organization Air Command and Control system.

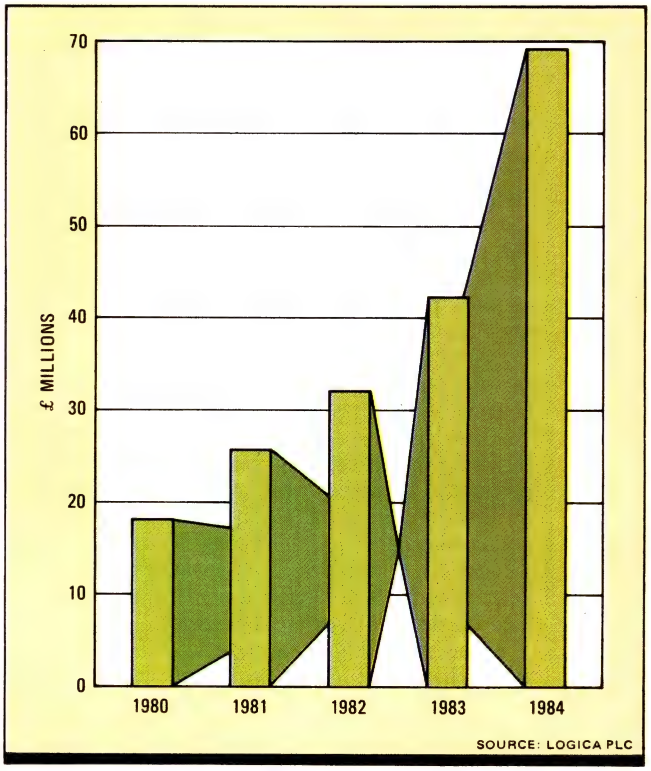
Logica encapsulates the experience gained in these projects in separate software kernels, or packages. Each package implements a particular system, such as a supervisory control system, electronic funds transfer, energy management, or medical billing, and can be tailored quickly to a customer's needs. These kernels can be moved around in a way that Logica's consultants cannot, and with them the company can exploit its skills in a worldwide market.

Today, for example, roughly 35% of Logica's sales are overseas. Just about 40% of this is generated in Europe, where Logica now has five local operations. "We see Europe as a market where British companies must succeed," says Hughes.

The company has expanded organically, by acquisition and through joint ventures. For example, it recently bought Intelligent Technologies International, a Palo Alto company that sells software to link IBM Corp. Personal Computers with IBM mainframes. At the same time, Logica formed two new joint ventures. In Hong Kong, it teamed with Jardine Matheson and Co. to set up a new company, called Jardine Logica Systems Ltd., to provide computer consultancy and custom-built software and hardware systems in southeast Asia. Meanwhile, in Italy, Logica has purchased half of General Systems SpA, one of Italy's leading software and systems companies. The price was $750,000.

Goodwill? In the U.S., however, the company's operations have bogged down. In six months last year, its New York subsidiary lost nearly $1 million on fixed-price contracts that developed snags. The projects "sucked in resources," says Berg. "But the clients are now happy, and a lot of goodwill has been generated." Logica's U.S. activities center on three areas: banking, computer companies, and communications.

But it is the company's forays into hardware manufacturing that most worry investors. Like other consulting firms, Logica has long had the ability to produce special-purpose hardware, such as its Logos continuous-speech recognizers sold under license to Racal Electronics plc and Smiths Industries plc. But its emergence as a maker of word-processor systems and networked office products is putting the compa-



SOURCE: LOGICA PLC

Enviable performance? Logica has had a growth rate of nearly 30% per year, which led it to go public in 1983. But its record could have been better, observers say.

Unique. "One thing that makes us unique is the diversity of our business," says Richard N. Berg, Logica's commercial director. Its consultancy "gets us a lot of exposure at high levels."

ny on a more difficult growth path.

Logica began hardware manufacture in the early 1970s with a multiuser word processor developed for Unilever Ltd. Then came its VTS 2200, marketed under license by ICL. Last year, it introduced Kennet, its networked office equipment, and Polynet, a local-area network. The moves worry investors because they pit the firm against some heavyweight competition.

James Dodd, an analyst at Fielding, Newson-Smith & Co., in London, is bullish on Logica. "We are convinced of the high quality of Logica's mainstream systems implementation and software business." But Dodd notes that "the more Logica moves into provision of advanced office equipment, the more the company will have to lock horns with companies such as IBM and Wang."

Niche philosophy. "We are not going to compete on price," replies Logica's Berg. "The company's strategy is to find market niches selling custom systems to large corporations and government departments." But Logica also licenses other manufacturers to sell its system, and that can leave the company vulnerable, too. When ICL's deal to sell the VTS 2200 word processor came to an end recently, Logica had to be ready with another outlet. It found one in British Telecom, but the incident underscored Logica's potential problems in the hardware business.

Michael Bean, an analyst with Henderson Crosthwaite & Co., in London, believes that Logica's stock is overpriced. "Logica has been wrongly evaluated as a systems and software company, but a significant proportion of its revenues now comes from hardware sales. And that is, to my mind, a different matter. I am very cautious about any small British manufacturer of microprocessor hardware."

Bean believes that Logica's hardware sales could also suffer from the loss of ICL's original-equipment-manufacturer contract, because British Telecom's marketing operation "is still an unknown quantity."

One other potential brake on Logica's growth could be a shortage of skilled programmers. Because the revenues of software consultancies depend largely on fee revenue, income growth is related closely to growth in staff. Logica is better than most companies at keeping and attracting staff, says Fielding's Dodd. It offers its employees stock options and, as a London-based outfit, can attract its share of bright graduates. But regardless of all these lures, the general shortage of skilled software engineers is now reaching crisis proportions, and the firm may feel the pinch.

Two-edged sword. Logica's greatest strength, and a possible source of danger, is its technology. The firm is now entrusting the task of keeping it sharp to a new laboratory near Cambridge University—the school's prestigious Computer Laboratory—and a ready supply of talented computer graduates. At the lab, Logica is focusing on four key technologies: very large-scale integrated chip design using silicon compiler techniques, intelligent knowledge-based computer systems, software engineering, and speech recognition. These programs are aided by participation in half a dozen European and UK fifth-generation computer projects. The programs "are allowing us to accelerate our rate of research," says Berg.

This sort of technical competence could make Logica a tempting takeover target for even bigger fish. Software, like integrated-circuit technology before it, is an increasingly important—and ever scarcer—resource. Just as the big conglomerates bought up the independent chip makers, they may also seek out the software companies. "We partly recognize this with our emphasis on forming joint companies," says Berg. It remains to be seen whether the big guys will be content to admire the likes of Logica from afar or want to get into bed with them. *–Kevin Smith*

BOTTOM LINES

Salaries go up for college graduates. Average starting salaries for this year's graduates with BS degrees will range from $24,151 to $30,432, according to the results of a survey by the American Electronics Association. This is up from the $22,884 to $29,016 range that was given by hiring companies who were surveyed last year, the trade group says. "Salary offers continue to rise because of consistent demand for BS graduates from the electronics industry," the AEA notes. Salary offers vary from area to area, it points out, because of local supply and demand conditions as well as differing cost-of-living rates.

Ashton-Tate buys Framework firm. Ashton-Tate, a leading microcomputer-software vendor, has agreed in principle to buy Forefront Corp., the Sunnyvale, Calif., developer of the popular Framework multifunction software program marketed by Ashton-Tate. Terms of the acquisition were not disclosed. "The purchase of Forefront Corp. is part of Ashton-Tate's corporate strategy to expand our developmental strength and capture the best and brightest of the industry's technical resources," says Ashton-Tate president Edward M. Esber Jr. The firm began shipping Framework in July 1984; the package accounted for 18% of the company's $82.3 million in revenues in fiscal 1985, which ended Jan. 31. Forefront, which has 17 employees, will continue to operate in Sunnyvale as part of Ashton-Tate's research and development activities.

Mentor Graphics plans stock sale. Engineering-work-station vendor Mentor Graphics Corp., of Beaverton, Ore., plans to offer about 2 million shares of common stock to the public. The offer will consist of both company- and privately owned stock. Mentor said that proceeds from the sale of company-owned stock will be used for general corporate purposes, principally working capital and capital expenditures.

Intelledex raises venture financing. Intelledex Inc. has raised nearly $10 million in a fourth round of venture financing. The Corvallis, Ore., firm, which makes robot and vision systems, says there have been two preliminary closings totaling about $9.7 million, with a final closing yet to occur. The capital "gives us the financial resources to sustain our growth and our position as a market leader," according to company president S. Stanley Mintz. Last fall, the company completed a $3.5 million research and development limited partnership to design a high-speed inspection vision system.

PLAYERS

NAKAJIMA LEADS AIWA INTO DIGITAL AUDIO AGE

Digital push. Aiwa president Nakajima, who brought studio-quality sound to digital audio, wants Aiwa to develop more digital products.

Tokyo

Japan's pioneer in digital audio, Heitaro Nakajima, 64, is counting on his cumulative expertise to lead Aiwa Co. into the age of consumer digital electronics. Beginning his second year as president of the consumer-audio manufacturer, Nakajima expects sales during fiscal 1985 to increase to $320 million, from $298 million in 1984, despite a depressed audio market.

"Aiwa must become digital. Telephones are becoming digital. Audio will all become digital, and the sound track on 8-mm VCRs will become digital," he explains. The firm has just started to produce microcomputer digital data recorders that use audio cassettes—the first of what Nakajima hopes will be many new products that don't compete directly with those of parent Sony Corp.

Ironically, a successful early career in analog audio engineering taught Nakajima the limitations of analog. While at the Technical Research Laboratories of Nippon Hoso Kyokai, Japan's public-service broadcasting system, he developed the basic design of the capacitor microphone still used in broadcast studios.

Analog to digital. But when he tried to improve the overall quality of FM broadcasts, Nakajima found that "the limiting factor is the analog tape recorder [used for playing music over the air] and that there is no feasible way to improve it." So he developed a method of recording studio-quality audio signals in digital form on video-tape recorders. "It was successfully used by Nippon Columbia to build a system for recording digital master tapes," he reports. His achievement also earned him a commendation on April 15 from Japan's Minister of State for Science and Technology.

Sony Corp. was selected to manufacture Nakajima's capacitor microphone. Nakajima's subsequent contact with Sony "led to the start of my second career at Sony in 1971 as director of the firm's audio research lab and head of its Audio Division." Under Nakajima, the lab developed a pulse-code-modulation processor for audio recording on video cassette recorders, and worked with other firms on industry standards.

Sony thus had available the digital technology that it contributed to make the compact-disk digital audio laser player a superlative industry standard soon after Philips of the Netherlands had developed a prototype system. By then, Nakajima also was coordinator of companywide development, which included products—TVs, VCRs, audio equipment—and components made by Sony and used in products such as semiconductors, picture tubes, and compact disks. *–Charles L. Cohen*

MIN BLAZES BRIGHT PATH FOR KOREA'S GOLD STAR

Seoul

When P. June Min was a graphics systems project manager at IBM in 1973, a senior executive there described him as "astute, hard-driving—a man who can be counted on to get things done. There is a feeling of electricity in his [work] group."

Now the senior managing director of Gold Star Semiconductor Ltd., Min is still hard-charging. And though his office in Seoul may not give off an electric glow, it is filled with the exuberance of a young company that has big plans.

One of a kind. Born in South Korea, Min, 49, earned an MS in electronics engineering and a PhD in computer science from Purdue University. He put in 10 years with IBM Corp. and 2 years with Xerox Corp. before returning home. "In America, I could be one talent among many. In Korea, I could be unique." Min hopes the Lucky Gold Star conglomerate's growing semiconductor operation will also become unique—as the first Korean success story in a rough-and-tumble local marketplace.

Min predicts that Gold Star will do $200 million worth of business this year alone—after just five years of existence. In part, he hopes to achieve this by establishing ties with such U.S. firms as AT&T, Zilog, Advanced Micro Devices, and LSI Logic.

Big blue start. After earning his advanced degrees, Min had plenty of job offers. He chose to work for IBM, however, "because it offered me that project-development chance I wanted."

Min rose to senior manager at IBM, starting up a companywide system that cut computer service costs by 60% for a wide range of computer and peripheral products. He says this saved the company several million dollars annually. In 1977, he went over to Xerox Corp. in Los Angeles as program manager of office systems products. By then it was clear that all the major Korean conglomerates were planning to enter the electronic components business.

Through his cousin, who was the family doctor for the two families that own and operate the Gold Star group, Min was introduced to people in the company. While working for Xerox, Min simultaneously served as a consultant to Gold Star for a year and surveyed the U.S. market opportunities.

When the final decision was made to establish the new electronics firm, Gold Star made Min an offer. He came back to Seoul early in 1979 and took over the Gold Star Semiconductor group when it was established that September.

At Gold Star, Min works 13 to 14 hours a day. "That's including Saturday, of course. And even Sundays, we're working half the time. That's what it takes for us to get a foothold in this business." When asked whether he has any regrets about his decision to leave the U.S., Min replies, "None. I do miss the lifestyle we [he and his wife] had in the States, but this is a once-in-a-lifetime opportunity." *–Michael Berger*

Home again. After working for IBM and Xerox in the U.S., P. June Min moved to Gold Star Semiconductor in his native Korea.

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ASIA

THE FOUR DRAGONS RUSH TO PLAY CATCH-UP GAME

by Karen Berney

SOUTH KOREA AIMS TO TAKE THE JAPANESE ROUTE, BUT FASTER, AS SINGAPORE, TAIWAN, AND HONG KONG ALSO MAP PLANS

With Japanese companies already firmly established as dominant or nearly dominant figures in markets formerly owned by U.S. electronics manufacturers, other nations in Asia are eager to emulate the feat. In some cases their approaches are quite different from that of the Japanese: for example, several see themselves as partners of the U.S. rather than competitors.

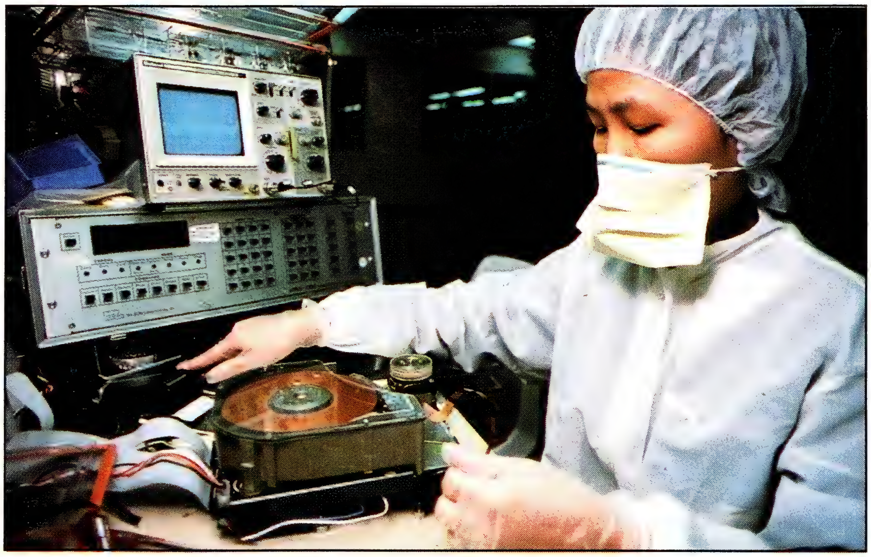
The first part of this two-part special report, last week, examined the situation in Japan, Malaysia, and Indonesia. This week, *ElectronicsWeek*'s reporters and editors take a look at what have been called the four dragons: South Korea, Singapore, Taiwan, and Hong Kong.

U.S. electronics companies, with their hearts and minds bent on beating back the Japanese challenge, haven't been paying much attention to the Republic of Korea. But if they contemplated the momentum of electronics development on that peninsula the size of Indiana, they might dub South Korea the next Japan. Yet there is a difference. Korea aims to do what Japan did, but intends to do it in half the time.

Seoul's strategy, however, is not unique. Its three-pronged approach—buy foreign technology, protect technology latecomers, and forge joint ventures with leading U.S., European, and Japanese electronics makers—is exactly what Japan followed on its way to becoming an industrial superpower.

The strategy has paid off and the U.S. is beginning to feel a pinch. Primarily export-oriented, Korea doubled its worldwide electronics shipments from 1981 to 1984, going from $2.21 billion to $4.25 billion (see chart, p. 49). Of that total, shipments of semiconductors, which Korean vendors hope will launch them into the forefront of world technology, grew by 31.3%, to $980 million, and exports of computer parts and peripherals by 49.3%, to $230 million. According to Dataquest Inc., Korea is the only one of the four dragons "that has developed a manufacturing base to produce high-value-added goods sufficient to sustain high growth rates over the next decade." The Electronic Industries Association of Korea says that its growth rate will be about 20%.

Korea's success in climbing up the technology curve with exports is paralleling a growing U.S. trade deficit in electronics. From 1980 to 1983, for



New faces of Asia. Typifying the accelerated high-tech thrusts of the nations known as the four dragons—Korea, Singapore, Taiwan, and Hong Kong—the women on the opposite page and at right work in Singapore's busy and growing electronics industry.

example, the U.S. enjoyed a surplus in computer trade. Then last year imports from Korea shot up 75% over 1983 and exports were off by 7%. The result: a $117 million deficit. In communications equipment and components, the U.S. has suffered an imbalance for years but lately it has been worsening. After showing only a marginal growth rate, Korean exports took a 40% jump, from $1.47 million in 1983 to $2.06 million in 1984. Overall, the U.S. ran close to a $2 billion electronics deficit (see chart, p. 51).

All this spells a new threat to the long-term competitiveness of the U.S. electronics industry, most executives admit. But they add quickly that in the short run, it is Japan that stands to lose the most.

"South Korea is coming on strong and will be a major force shaping the industry, but has targeted markets that are Japan's bread and butter," states Ronald Whittier, vice president of Intel Corp.

Meanwhile, U.S. companies, eager to satisfy a Korean appetite for semiconductors that will amount to more than $500 million in sales this year, appear to have no real reservations over transferring to Korean companies the technology that may eventually come back to haunt them. "What Korea becomes will be what the U.S., and to a lesser extent Japan, choose to make it," says Semiconductor Industry Association vice president Warren Davis.

More than any other Asian electronics industry, with the possible exception of Japan's, Korea's has grown up under the protective nurturing of its government. This support is patterned on the Japanese model in which bureaucrats and industry leaders plan together to mobilize technology, capital, and labor to attack high-priority markets.

In the early 1980s, the computer and semiconductor sectors were designated strategic industries and made eligible for government protection. An import ban was imposed on personal and minicomputers, making partnerships with domestic firms the only way for a foreign vendor to tap into the market. A flat tariff rate of 20% was placed on imported integrated circuits.

With the Korean computer market thriving at an annual growth rate of 33%, the import ban is working precisely as Seoul intended. Hewlett-Packard Co., for example, upon signing a joint venture with Samsung Electronics Corp. to manufacture the HP3000 Series 44 minicomputer, announced, "We look forward to contributing significantly to the Korean government's goals with regard to technology transfer, import substitution, and the development of exports."

SOUTH KOREAN ELECTRONIC EXPORTS
(billions of dollars)

	Total production	Total exports
1981	3.79	2.22
1982	4.00	2.14
1983	5.56	2.98
1984	7.30	4.25
1985 (est)	9.60	5.25
1986 (est)	11.90	6.50

SOURCE: ELECTRONIC INDUSTRIES ASSOCIATION OF KOREA

Elsewhere in the computer market, Samsung's version of a 16-bit microcomputer is being manufactured under license from NEC Corp., and Daewoo Electronics Ltd.'s IQ1000, a 16-bit model, has backing from Microsoft Corp. and its Japanese affiliate, ASCII Corp. In addition, Italy's Ing. C. Olivetti & C. SpA, in which AT&T has a 25% stake, concluded a deal with Gold Star Co. of South Korea in December for the production of its 16-bit PCM-24 personal computer. Now all three are discussing a joint software project for systems and applications packages linking Olivetti's model with the computer that Gold Star makes for AT&T.

Overall, foreign equity investments in electronics were close to $67 million last year. That is more than three times the 1982 total of $19.2 million, reports the Ministry of Finance.

In 1982, Seoul went a step further and instituted jointly funded research projects between the public and private sectors. Some 31 projects were singled out for subsidies, preferential credits, and other incentives. Seven are in electronics and cover a broad range. They include medium-size computers, cable telecommunications gear, numerically controlled machine tools and robotics, medical equipment, video tape recorders, digital ICs, and computer software.

A year later, the Semiconductor Industry Fostering Plan was launched to lend domestic firms $346 million over the 1984 to 1986 period. In 1984, an additional $91 million was set aside for a very large-scale IC project to develop a 1-Mb MOS dynamic random-access memory by 1989.

Training programs have been established to ensure the supply of highly skilled labor for the VLSI and other projects. During this decade, Korea plans to produce 1,360 semiconductor and 820 computer experts. In addition, the Korean Institute of Electronics Technology, which has a liaison office in Sunnyvale, Calif., conducts basic semiconductor research and then passes along the results to industry. The institute is currently using 3-μm feature sizes and producing 32-K ROMs with technology obtained from VLSI Technology Inc. And it is pushing into such areas as 8-bit CMOS microprocessors.

The major beneficiaries of this government encouragement have been Korea's four major conglomerates. Lucky-Gold Star Group, Hyundai Corp., Daewoo, and the Samsung Group have all rushed—some analysts say too hastily—into virtually every segment of the electronics business with different foreign partners but similar prospects.

Korean manufacturers, notably Samsung and Gold Star, hope their next hot-ticket item will be video cassette recorders. This March was the milestone month for the two as the two-year export ban in their VHS license from Victor Co. of Japan expired. The idea was to keep them out of the way of a head start in the U.S. and European markets. The other one of the big four companies, Daewoo, makes VCRs in the Beta format under license from Sony.

Despite Korea's ambitious plans for VCR exports—current production capacity of 620,000 units is being increased to 3.3 million units—the Japanese have hedged their bets against a potential Korean onslaught. Key to the fate of Korea's VCR competitiveness is local content. Some parts, like head drums, have been self-developed, but makers still have to turn to Japan for such critical components as precision recording heads [*ElectronicsWeek*, April 15, 1985, p. 22]. "Our domestic content for VCRs is about 60% but we just can't match the Japanese prices for most of the small components. Their economy of scale is so great," says one Korean executive.

Whereas dependence on imported parts could result in Japanese suppliers' confounding Korean price competitiveness, reliance on U.S. distributors could serve to inhibit its technology competitiveness. Korean companies are desperately seeking to change the image that their products are less expensive, low-quality versions of better Japanese counterparts, reports John Bennett of the Korean Electronics Institute in Washington. "But U.S. retailers want the cheaper models despite the quality tradeoff," he says. And to keep the Koreans in line, "the U.S. can simply play one company off against the other."

Although many Japanese firms have invested in Korea, the projects—such as VCR production—tend to call for technology that is no longer state of the art. Moreover, they are increasingly eyeing the nation's rapid progress as a threat and are resisting transferring their technology for fear of a boomerang effect, in which the commercial rival uses the company's own innovation to grab shares of its markets. This has pushed Korean conglomerates into the arms of U.S. companies, especially for the semiconductor technology to underpin their next export thrust.

The economic scope. The livelihood of these workers, as well as their homeland's economy, is intertwined with the fortunes of the electronics companies—U.S. and Japanese—that have plants there.

"There are two things going on in Korea," remarks the SIA's Davis. "The 1988 Olympics and the drive to be the world's third largest semiconductor maker by that time." Including government funding, six major firms will invest more than $2 billion in research and development and wafer-fabrication facilities by then. All share a common strategy: hire Korean-American engineering talent, set up product-design subsidiaries in Silicon Valley to license technology from U.S. companies, and mass-produce the results in Korea to take advantage of low labor costs.

Looking at the competitive picture company by company, Samsung is the largest investor, with $550 million. Under a technology deal with ITT Corp., a new VLSI plant in Suwon is turning out 180,000 4-in. wafers annually. Its U.S. subsidiary, Tristar Semiconductor Inc., is already producing 5-in. 64-K DRAMs in Santa Clara, Calif., after obtaining the design in a deal with Micron Technology Inc., of Boise, Idaho. And Intel has a tentative agreement to license a complete product line of microprocessors. Most recently, Samsung obtained an eight-year, $100 million loan in Hong Kong to underwrite expansion of the Suwon plant for production of 256-K DRAMs by September.

Hyundai, which made its electronics plunge two years ago with absolutely no experience in the field, has invested $500 million in Hyundai Electronics Industries of Korea and its U.S. operation, Modern Electrosystems Inc. The $40 million facility in Santa Clara can make 50,000 5-in. wafers a year; and Hyundai also has a domestic plant in Inchon that can make 200,000 3-in. wafers.

Hyundai has also broken ground in Inchon for a 6-in.-wafer-fab plant and will equip it with 25 Model 6300 wafer steppers purchased from GCA Corp., of Bedford, Mass. So far, the firm has three technology agreements, of which it has only disclosed two: a deal with Britain's Inmos Ltd. to second-source its 256-K DRAM, and one with Western Design Center Inc., of Mesa, Ariz., to make its 8- and 16-bit CMOS versions of the 6502 microprocessor. Last fall, Hyundai said it would be delivering n-MOS 16-K static RAMS and 128-K ROMs with a 1-K CMOS electrically erasable PROM to follow by early 1985. Now it says all three will be out by May 1.

Korean Electronic Co. is investing $430 million to develop linear and TTL devices but has no U.S. operation or licensing agreements. Another Korean company, this one with the largest IC assembly operation in East Asia, the Anam Industrial Co., plans to spend $310 million to double its capacity to 2.46 billion devices in 1986.

Gold Star, which has consistently invested in wafer-processing and IC-assembly facilities, will spend an additional $140 million during the period. Some $60 million will go into a Sunnyvale custom-IC design center, and an $18 million R&D center near Seoul will give the firm 5-in.-wafer production capability. Gold Star is getting know-how in CMOS technology as well as digital-switch and single long-wavelength fiber production from AT&T Co.

Finally, Daewoo has a Santa Clara subsidiary, ID Focus, and a $150 million budget. It has licensing and marketing agreements with Northern Telecom to produce the SL-1 private branch exchange and optical-fiber systems, but a deal on semiconductors was later dropped, apparently because of high capital costs. Daewoo Semiconductor Corp.'s managing director, Hong Jo Chang, says the company is still seeking "a foreign partner with whom we can share equity investment and enter the semicustom and custom market [that] we find more attractive than memory." The decision to terminate the semiconductor agreement, industry insiders believe, was prompted by a $60 million loss Daewoo has taken on a defective memory-production line it bought from the Korean Institute of Electronics Technology.

"Licensing technology to Korea is a good business move for U.S. companies," contends Thomas Kurlak, a semiconductor analyst with Merrill Lynch, Pierce, Fenner & Smith Inc. In addition to an up-front licensing fee, firms are getting a 1% to 2% royalty on future sales, rights to a certain percentage of Korean output, and access to low-cost labor markets.

Explains Arthur J. Davie, a veteran AT&T executive who is now chief officer of a Gold Star-AT&T joint venture: "We meet each other's needs. Gold Star is solving our objective of lowering production costs and building capacity, and we're meeting their objective of foreign marketing and broadening their product base. It remains to be seen, however, how such support will come back to hurt us," observes Kurlak. Yet, the biggest mistake, he cautions, is to view the challenge as solely a Japanese problem.

Korea is now very aggressive in 64-K DRAMs and should be able to sweep up what is left of the market until 256-K DRAMS take over. By 1988, Japan will have seized at least 65% of the 256-K market with the remainder split between U.S. and Korean suppliers.

"Actually, it's Japanese momentum which is unstoppable," Kurlak says. "If Korea is going to take a bite out of anyone's business, it's going to be ours."

Indeed, it will be Japan and not the U.S. that puts up the stiffest fight, adds Dataquest analyst Sheridan Tatsuno. "By no means is Japan going to roll over and die" once Korea joins the fray with the 256-K product, he states. Initially, the Japanese will exert price pressure in the 64-K market to keep Korean profit margins extremely thin. At the same time, they will continue to open plants in the U.S. to ensure that U.S. suppliers won't be bumped during supply shortages.

And, as a final blow, Japan will leapfrog to the 1-Mb DRAM, causing the 256-K market to collapse for both U.S. and Korean suppliers, he predicts. The upshot is that "Korea is going to find the competition a lot tougher than it thought," says Tatsuno.

U.S. industry executives are also skeptical but for different reasons. "First of all, licensing is no guarantee of the capability to innovate," stresses George Scalise, senior vice president of Advanced Micro Devices Inc., which is currently considering such an arrangement in Korea. Second, Korea has neither the name recognition nor the sales force to penetrate the U.S. market, he argues.

In the opinion of Intel's Whittier, Korea may indeed triumph in its battle to become a major supplier of memories but it could be a Pyrrhic victory. "What is the country going to do with its tremendous capital investments after it masters memory-chip production?"

The logical step is to advance to microprocessors, controllers, and application-specific ICs, but Korean companies will need foreign partners to accomplish that. Given the reluctance of U.S. and Japanese firms to share state-of-the-art technology, the best Korea can hope for "are deals that will bind it to the lagging edge of technology," he thinks. Hence the Intel-Samsung exchange, which he describes as being for "technology at least two generations old."

Besides external barriers, Korea also faces ones of its own making: the number of competitors in the race. "The Koreans will succeed overall in getting into a variety of markets, but they are doing it at a high price," says a foreign banker. "There are too many companies in the running. The government should have seen that much earlier." Daewoo's Chang acknowledges as much when he suggests Korean chip makers "shouldn't compete with one another. We should divide our needs—'I'll buy logic from you if you'll buy memory from me,' and so on."

The country appears to be heading in the same direction—signing up with overseas manufacturers—with regard to optical fiber. Four companies have licensing agreements with foreign vendors: Gold Star and AT&T, Samsung and ITT, Daewoo and Northern Telecom, and Taihan Electric Wire Co. and Sumitomo. All seem convinced that the potential demand is there to keep their plants humming and recoup their considerable investment, even though they are now operating at 30% of capacity and U.S. and Japanese technology is some two years ahead of what the Koreans have. "It just doesn't make sense. There are going to be some big losers here," asserts a U.S. banker based in Seoul and familiar with the fiber-optics situation.

Technologically, Korea also has a way to go to meet international quality standards. Increasing yield in semiconductor production to boost reliability and competitiveness, and upgrading its meager ability in software are two of the most formidable tasks facing the industry. But without a substantial change in R&D practices, Korea could be condemned to follow in the shadows of others. Currently, electronics firms invest only 1.3% of sales in R&D. Only Gold Star is reported to be spending more than 3%.

"I admit it, our timing is late but we have a successful strategy: leave the marketing and technology development to our U.S. partner and build up our own ability to produce high-quality products in high quantity. We're going to achieve our goals," says the optimistic senior managing director of Gold Star Semiconductor, P. June Min.

The prospects for making it in the U.S., however, could dim as the U.S. trade deficit with Korea continues to soar. In 1984, the figure climbed to $4 billion from $1.7 billion. To date, U.S. companies have not made a political issue about restricted Korean markets the same way they have about Japan's. But if Korea floods the U.S. with VCRs, semiconductors, automobiles, and other consumer products, a wave of anti-Korean sentiment could begin to swell.

"Yes, there certainly is a danger that trade frictions will develop," claims Leonard Santos, counsel to the Senate Finance Committee. With an extensive tariff structure to protect struggling and infant industries, Korean markets are even more closed to U.S. products than Japan's, he notes. *–Reported by Michael Berger*

U.S. HIGH-TECH TRADE WITH SOUTH KOREA (millions of dollars)

Category	**1980**	**1981**	**1982**	**1983**	**1984**
Communications equipment and components					
Imports	772.2	883.3	943.9	1,474.4	2,067.6
Exports	337.9	385.2	623.0	710.1	720.5
Office computing and accounting machinery					
Imports	42.9	65.4	97.9	161.5	286.2
Exports	62.9	85.3	111.3	182.1	168.8
Professional and scientific instruments					
Imports	85.7	96.3	77.5	95.7	134.0
Exports	61.5	75.4	108.0	108.2	131.4

SOURCE: U.S. DEPARTMENT OF COMMERCE, INTERNATIONAL TRADE ADMINISTRATION

SINGAPORE CASTS LOT WITH SOFTWARE

Although a steady flow of U.S. investment has vaulted tiny Singapore into the ranks of major electronics-producing nations, it has not sparked a flourishing domestic industry. And nothing is likely to change that picture in the near future, agree Western and Singaporean analysts.

"It's absolutely inconceivable that a local company could develop into a major force in electronics on the scale of, say, an internationally competitive Samsung or Hyundai in South Korea," declares Ray Ho, second vice president at the Singapore office of Chase Manhattan Bank. Singapore, only 2.7 million people strong, commands neither the market size nor the material resources necessary to climb up the technology ladder, he says. "You might see a local company advance from production of a single-layer printed-circuit board to a multilayer pc board, but it's hard to imagine they would progress to integrated circuits."

So the Singaporean government, aware that it can't compete with its East Asian neighbors in hardware manufacturing and that it faces a labor shortage expected to worsen throughout the decade, has targeted what it terms the knowledge-intensive, or brain, services as the industries that will lead the country into future prosperity. The stated objective is to make Singapore the software capital of the Far East by 1990. Spearheading the drive is the National Computer Board, a voluntary organization made up of representatives from industry, government, and academia.

The board's strategy is threefold. First and foremost is an effort to build up Singapore's meager supply of software talent, now consisting of about 2,800 programmers, two thirds of them systems analysts. Through sizable government outlays, such as $26 million to build the NCB's new in-house 8,758-yd^2 computer-training institute, the board hopes to raise the annual number of new programmers from 300 now to 700. The aim is to have 9,000 programmers available by 1990.

Second, Singapore is actively promoting the growth of computer utilization to spur local interest and awareness of software as well as to alleviate the labor shortage. That policy has proved to be a boon for U.S. computer exporters. The government allows companies to write off the full cost of a computer in the first year after purchase, and there is no tax levied on either hardware or software imports. Naturally, computer use has skyrocketed.

The third approach is technology transfer. The software industry has a large number of small companies; about 60% provide consulting and turnkey services and the rest original-equipment-manufacturer services. For the most part, however, they have minimum expertise and lack the resources necessary to be in the export business, reports the NCB. The key "is to get suitable foreign leading computer companies and encourage them to set up software centers," it concludes.

Ironically, that goal has been advanced in what has become the world's biggest legal haven for both hardware and software piracy. Last November, for instance, IBM Corp. requested and failed to get an injunction against freewheeling copying of its proprietary basic input/output system. The government, however, appears to have caught on that inadequate protection could turn the NCB's plans to dust. As Singapore opened its 1985 parliament, Minister for Law E.W. Barker indicated that a new copyright law covering protection for software is scheduled for passage this July.

"They're struggling to put foreign parties at ease," says Michael R. Moyle, of the San Francisco law firm Graham & James. It makes good sense, he points out. As Singapore's own software products enter the export market, the government will be seeking reciprocal protection.

In another sign of its determination to gain legitimacy and thereby enlist foreign support, the NCB signed an agreement in March with the U.S. Institute for Certification of Computer Professionals to conduct examinations to award Singaporeans ICCP programming certificates.

The Japanese, seeing Singapore as an ideal platform from which to penetrate and service the regional market, have been quick to cooperate with the NCB's plans. NEC Corp., for instance, has invested $14 million in a software center that became operational in April. The center will help meet the spiraling Japanese software demand as well as develop packages for export.

Getting it together. Much of the electronics industry of the four dragons is devoted to assembly work. Each country is trying in its own way to expand beyond that limited horizon.

The Japanese government has also joined in. Donating both money and advisers, it established the Japan-Singapore Institute of Software Technology in February 1982 for training 150 programmers annually. The institute should become a model for other Asian countries where Japan wants to train personnel in the fields of microelectronics, biotechnology, and basic materials engineering. Toward that end, it set aside $300 million in its 1985 budget.

Bent on countering a potential Japanese edge, U.S. firms have been just as active if not more so. With the help of experts and equipment furnished by Grumman Corp., Singapore will open a computer-aided-design and -manufacturing research and development center at Nanyang University in June 1986. Last May, Sperry Corp.'s Computer Systems Division inaugurated a software complex for development of the firm's document-retrieval system, Unidas, as well as Mapper, a fourth-generation applications development system. Following close behind was Hewlett-Packard Co., with plans to build a software research center, and IBM, which announced a program to aid local entrepreneurs in writing and marketing

IBM-compatible applications programs. Most recently, Digital Equipment Corp. proposed its own software center to conduct hardware design and prototype development as export-oriented activities.

Despite the NCB's success in getting foreign firms to train local software talent, few see this growing manpower pool as the core of an emerging Singaporean software industry. As one Western analyst puts it: "The Silicon Valley culture needed for that just doesn't do well down here. Singapore's rigidly regulated society just doesn't spawn the kind of spontaneous geniuses who created Apple. They would be too disruptive to the kind of system the government wants. It doesn't encourage that kind of entrepreneurial uproar." Thus "you'll probably see more and more local companies appearing on the support and supply side, but that's as far as it will go," predicts Chase Manhattan's Ho.

Consequently, Singapore is probably destined to remain an ally rather than a competitor of the U.S. electronics industry. In that sense, East Asia may be divided into two categories, theorizes Chua Soo Tian, divisional director for Singapore's aggressive Economic Development Board. "First you have Japan and now South Korea, which have developed indigenous electronics industries that are challenging America's dominance. Then you have countries like ourselves that are collaborating in meeting that challenge."

Indeed, Singapore's electronics industry has been American made. Chua estimates that U.S. participation in Singapore accounts for close to 75% of all foreign investment, with the Japanese a distant but rapidly rising second. Some 40 American electronics makers have pumped more than $700 million into Singapore joint-venture and subsidiary operations, according to the U.S. embassy. Investment is led by computer parts and peripherals, with a trend toward more value-added production for such items as pc boards, magnetic heads for disk drives, and industrial-grade connectors and resistors.

U.S. HIGH-TECH TRADE WITH SINGAPORE (millions of dollars)

Category	1980	1981	1982	1983	1984
Communications equipment and components					
Imports	1,036.8	1,156.7	1,135.1	1,118.9	1,384.2
Exports	553.9	571.4	539.6	589.5	643.2
Office computing and accounting machinery					
Imports	57.4	70.3	222.8	711.6	1,036.0
Exports	76.1	109.9	171.7	366.0	459.5
Professional and scientific instruments					
Imports	55.0	60.9	44.4	44.1	62.3
Exports	58.2	69.6	78.4	72.8	83.8

SOURCE: U.S. DEPARTMENT OF COMMERCE, INTERNATIONAL TRADE ADMINISTRATION

Thanks to U.S. investments by Tandon Corp. and Seagate Technology, the industry's top performers, Singapore is now the world's leading exporter of disk drives, shipping over $300 million worth of product annually. In computer equipment, Singapore ranks only behind Japan as an exporter to the U.S. Last year's sales topped over $900 million.

The upshot is that Singapore has had the greatest success of the four dragons in shifting away from labor-intensive low-value assembly and into more lucrative, capital-intensive production. In 1984, the growth of industrial electronics edged out consumer electronics for the second consecutive year. The combined total, of which industrial equipment is more than half, exceeded $3.5 billion, up more than 20% over 1983.

Although often noted for comparatively high labor and production costs—wages in Singapore lag only behind Korea's at $225 to $275 a month—Singapore is expected to remain America's largest Asian base for manufacturing, marketing, and service. While low labor costs initially attracted Hewlett-Packard to Singapore 15 years ago, many other reasons have kept it there since and inspired the firm to commit $100 million to an ambitious expansion program, reports Walt Sousa, HP's Singapore director.

"We look upon Singapore as a technology resource center. If we just wanted to build low-cost components, we wouldn't have come here," confirms operations manager David Gates, of Data General Singapore Ltd. The company is investing $30 million in two facilities, one for production of multilayer pc boards and the other for construction and sale of its MV4000 superminicomputer in Asia.

The lures that more than compensate for relatively high overhead include Singapore's strategic location, a solid infrastructure, a disciplined and English-speaking labor force, and the government's no-nonsense support for the electronics sector. With the assistance of the Economic Development Board, electronics investors can qualify for "pioneer status"—a designation that guarantees tax-free status for up to 10 years, depending on the type and size of a project.

The board also provides subsidized land or rentals in government industrial parks and financial support through the Development Bank of Singapore. In fact, a company interested in a quick startup "can be rolling out products within three months from the time it begins exploratory discussions with us," boasts Chua.

Finally, the lack of regulations governing trade and finance—there are no import-export and foreign-exchange controls, and no tariffs whatsoever—has proven to be an added enticement. Not long ago, Motorola Inc. was considering Malaysia as a site for a new plant to build pagers and radio telephones. But because of a web of bureaucratic tangles encountered in Kuala Lumpur, the company decided to migrate south to Singapore. "That's one advantage of being here. There is not much bureaucracy, no paperwork involved in moving goods in and out," notes Sousa.

If there is any competitive challenge to Singapore's electronics industry, it is most likely for a bigger stake of the business. In that respect, American dominance is being threatened from both European and Japanese manufacturers in the colony. Ho cites the decision of Italy's SGS-Ates to invest $35 million in wafer fabrication as the most significant recent happening in the industry. IC makers are watching closely. Should SGS prove that wafer fab can be done in a cost-effective way, "I'm certain you will find others, including U.S. firms, following suit," Sousa contends.

But to keep that investment stream running, analysts say that Singapore must remedy the shortage of skilled labor. For example, United Electronic Engineering Corp., a Mitsubishi subsidiary, reportedly wanted to double production of TVs and radios at a Singapore plant but had to scratch the plan when it could not round up enough skilled workers.

With regard to its own workforce, government funds have been allocated for on-the-job training and upgrading workers' skills. But the solution may lie with Singapore's East Asian competitors. The Labor Ministry announced in February that local firms would be permitted to import skilled workers from Hong Kong, Taiwan, South Korea, and Macao. It remains to be seen, however, whether those countries, with their own fast-paced electronics-development programs, are willing to help Singapore. *–Reported by Paul Zach and Ann Jacobs*

TAIWAN

LOOKING BEYOND LOW-TECH ASSEMBLY

Marching in step with its East Asian competitors—South Korea, Singapore, and Hong Kong—Taiwan wants to leave the realm of labor-intensive low-tech assembly and enter the kingdom of high-value-added electronics production. Like its rivals, Taipei offers generous incentives to foreign firms that can help in that effort. But Taipei has an additional asset to leverage: the largest pool of electronics talent outside of Japan. Over 25,000 engineers and scientists emerge annually from Taiwan's schools.

Yet the best and brightest among them—60,000 so far—have fled Taiwan to pursue more lucrative opportunities in the U.S. and Europe. Wooing these experienced managers, marketers, and researchers has therefore become the goal toward which Taipei's electronics-development strategies are now directed. The pitch is nothing less than ethnocentric: come home and prove that the Chinese can create and export foreign technology as well as imitate and import it.

It is this ongoing attempt at a reverse brain drain that was the impetus behind the establishment five years ago of the 5,000-acre Hsinchu Science-Based Industrial Park, one of three major organizations promoting Taiwan's high-tech future. The aim is a "Silicon Plateau" 40 miles south of Taipei.

U.S. HIGH-TECH TRADE WITH TAIWAN (millions of dollars)

Category	1980	1981	1982	1983	1984
Communications equipment and components					
Imports	1,264.1	1,480.2	1,539.3	1,878.4	2,397.1
Exports	325.1	340.7	344.2	401.7	414.5
Office computing and accounting machinery					
Imports	60.8	130.0	172.3	379.4	791.5
Exports	84.3	111.4	134.1	171.3	261.3
Professional and scientific instruments					
Imports	193.3	247.2	276.9	280.5	330.3
Exports	94.6	98.2	109.4	104.9	90.2

SOURCE: U.S. DEPARTMENT OF COMMERCE, INTERNATIONAL TRADE ADMINISTRATION

Choh H. Li, director of Hsinchu and himself a returnee (he was formerly director of research at Honeywell Inc., in Minneapolis), explains that about one third of the 42 companies in the park were set up by Chinese engineers from overseas, one third by foreign investors, and one third by local companies. In exchange for substantial incentives, such as duty exemptions on imported machinery and materials as well as government grants for up to 49% of the cost of startup capital, Hsinchu residents must agree to conduct significantly new research and development, employ and train local talent, and license technology developed at the park to local enterprises.

Vitelic Corp., founded by Alex Hu, former director of very large-scale-integration research at Fairchild Camera & Instrument Corp., is a pioneer of the trend Taipei is so actively encouraging. Started in 1983 as a Santa Clara, Calif., design house with plans to produce VLSI CMOS memory products for application-specific markets, Vitelic was finding it "near impossible to leap the cost-of-capital hurdle," reports vice president of marketing Jack Ordway. Taipei offered Vitelic a deal it couldn't refuse—a low-interest loan covering half the funds to build a $70 million, class-10, 1.3-μm-wafer fabrication facility if it would locate in Hsinchu. Vitelic signed on because "the arrangement will allow us to begin marketing 64-K dynamic random-access memories without a major investment in plant and equipment," says Ordway. In return, Vitelic will furnish its design masks and production know-how to Taiwan's 1,600-member Electronics Research and Service Organization staff, which is charged with developing prototypes and transferring the results to the private sector.

ERSO has similar agreements with two other little-known U.S. startups—Quasel Inc., in Santa Clara, Calif., and MOS Electronics Corp., Sunnyvale, Calif. Thanks to ERSO's efforts, Taiwan has planted the seeds for a home-grown semiconductor capability. It has already successfully mastered and marketed n-MOS, CMOS, and bipolar integrated-circuit technology and is now aiming for development of VLSI 1.5-μm prototypes under a $70 million government project.

But with ERSO and the United Microelectronics Corp. as the country's only wafer foundries, Taiwan will be hard-pressed to compete against Japan and South Korea. Therefore, ERSO wants to steer clear of mass-produced memory chips, concentrating instead on gate arrays to serve the semicustom market. Backed by a $100 million government loan, United Microelectronics plans to set up more than 10 overseas marketing and design centers in the U.S. and Europe within the next four years.

ERSO also drives Taiwan's computer industry, which, along with semiconductors, has been singled out to lead the nation into the high-tech era. Local firms are using ERSO's 8- and 16-bit microprocessor designs to make microcomputers and to produce 5¼-in. floppy-disk drives, dot-matrix printers, and terminals, albeit with imported components. Taiwan's well-known success in microcomputers, however, came initially from counterfeiting, particularly of the Apple II's design. An independent design and production capability has remained elusive.

The government is arduously trying to change that. Since early last year, when a district court sentenced six firms for infringement of Apple's copyrights, Taipei has forbidden copying of foreign designs. As a result, local manufacturers have initiated R&D programs for read-only memories, RAMs, and printed-circuit boards. Through ERSO support and entrepreneurial efforts, Taipei hopes computers and peripherals will become one of its top three exports—the other two are textiles and consumer electronics—over the next four years. The goal is 2% of the $230 billion worldwide market by then.

Taipei's plans are no less ambitious in telecommunications. Whereas its current 10-year plan singles out electronic components as a $2 billion industry accounting for 5.7% of total manufacturing by 1989, telecommunications is slated to grow into a $3.3 billion business, grabbing 9% of total output.

Currently, Taiwan's 1,193 telecommunications producers turn out low-end gear such as telephones, switchboards, and walkie-talkies. New items to be developed through a $70 million government-sponsored R&D fund include digital private branch exchanges, time-division-multiplexing equipment, modems, photocouplers, and satellite earth stations. The authorities have also set up a marketing-information clearinghouse and credit-guarantee services, and they have promised to favor local firms in public procurement, which accounts for 90%

of telecommunications consumption. Under a plan to upgrade Taiwan's telecom system into an integrated digital service network by 2001, spending will annually approach $125 million—money that would have gone to foreign sources.

Completing the government's electronics troika is the Institute for the Information Industry, ERSO's counterpart on the software side. With perhaps the most lofty aspirations of all, the institute aims to transform a fragmented $300,000-a-year industry into East Asia's most dynamic software force. The object is to spew forth packages worth $3.2 billion by the end of the decade. In this regard, Taiwan has made less noise about its goals than has Singapore, but most observers believe Taiwan's industry, though still struggling, has an edge over Singapore's because of widespread computer literacy.

The institute's support for software ranges from simple training programs to such heavy-handed methods as forced foreign cooperation. In September, the Industrial Development Bureau of the Ministry of Economic Affairs announced that any foreign vendor with a government software contract must hand over some of its business to a local company: for contracts over $2.5 million, subcontracting must account for 25% of the total value, and for those under that amount, subcontracting must make up 35%. Another government edict, which extends through 1989, calls on electronics makers to earmark a minimum of 1.5% of annual revenue for R&D. For the software industry, the requirement is 2%.

The multibillion-dollar implications of Taipei's policies have not been lost on U.S. firms, which maintain 52% ($731.6 million) of total foreign investment in the industry. Those without joint ventures are forming them, and those with a stake in the ground are driving it in deeper. AT&T Co., for example, is investing $30 million in a $40 million joint venture to build 200,000 sets of its ESS-5 digital switching systems in Taiwan. Hewlett-Packard Co., which shares 52% of Taiwan's microcomputer market with Digital Equipment Corp. and Wang Laboratories Inc., recently agreed to furnish technology and equipment to the institute to develop software for its 3000-series computers. General Instrument, RCA, TRW, and Texas Instruments also plan to upgrade their products and boost capacity.

Taiwan's multipronged development strategy is beginning to pay off. Sales to the U.S. of computer equipment, Taiwan's fastest-growing value-added industry, reached $791 million last year, more than double 1983's total (see chart). Overall, the island's electronics exports surged by 34.5%, to $5.05 billion, with the U.S. absorbing nearly half the total.

But because much of the performance is being sparked by foreign activity—about 70% of all Taiwan's electronics output is produced by foreign firms—it is still too early to view Taiwan as an emerging mini-Japan.

Observers argue that despite extensive planning and financial support from the government, Taiwan's 2,000-plus electronics firms—with an average of 93 employees each—are too small to obtain the investment needed to succeed in the cutting-edge technology markets. Small size also stands in the way of marketing. One of the biggest barriers to the growth of a potent Taiwanese industry has been the lack of marketing channels and know-how.

While not forcing mergers, the government strongly advocates them, especially in the software sector. The size of Taiwanese software companies is a major deterrent to growth, according to the institute, because buyers tend to believe that small vendors may not be around to service the packages they sell. Others, however, contend that Taiwan makes up for its size with entrepreneurial spirit, which, coupled with the expatriate and local engineering resources, could very well allow Taiwan to pull off the transition to technology-intensive electronics. *–Reported by Don Shapiro*

HONG KONG

LOCATION, LAISSEZ-FAIRE ARE LURES

American electronics companies are wasting no time fretting over Hong Kong as a potential competitive threat. There's simply too much business to be done in that fast-growing corner of the world, and Hong Kong, they agree, is the ideal place from which to pursue it.

Nor has Hong Kong's political fate—the return of the colony to Chinese sovereignty in 1997—served to dampen their enthusiasm. Immediately after the signing of an agreement between London and Beijing last September that calls for a 50-year transition period of joint Hong Kong-Chinese governance, three major U.S. electronics concerns either established or expanded manufacturing facilities there.

"We were well aware of the negotiations [between Britain and the People's Republic of China] when we made our decision to invest in a $12 million facility to make multilayer capacitors," reports Donald McGuinnes, executive vice president of Sprague Electric Co. Furthermore, "we recognized that an agreement would be reached and that it is very much in Beijing's interest to maintain prosperity in Hong Kong." His North Adams, Mass., firm studied several possible East Asian sites before settling on Hong Kong. Although its land and labor are more expensive than in other countries, Hong Kong won on the basis of its geography and communications.

In Lowell, Mass., Edward Yang, a vice president at Wang Laboratories Inc., shares that view; Wang recently opened a 25,000-ft^2 regional service and purchasing office in Hong Kong. "The announcement of the Sino-British declaration allows the fundamentals of the Hong Kong economy to continue in much the same manner as now," he observes. "We expect Asia to experience the fastest growth rate in office

U.S. HIGH-TECH TRADE WITH HONG KONG (millions of dollars)

Category	1980	1981	1982	1983	1984
Communications equipment and components					
Imports	466.3	523.6	602.5	853.7	1,110.5
Exports	238.5	267.3	267.7	333.3	463.1
Office computing and accounting machinery					
Imports	233.8	266.5	232.4	524.5	768.2
Exports	251.7	257.1	221.6	334.4	445.3
Professional and scientific instruments					
Imports	358.9	431.4	348.3	472.4	514.3
Exports	98.8	115.3	109.1	104.3	117.4

SOURCE: U.S. DEPARTMENT OF COMMERCE, INTERNATIONAL TRADE ADMINISTRATION automation in the next few years," a prediction echoed by Massachusetts neighbor Digital Equipment Corp., in Maynard, which is building a second plant on the Kowloon peninsula. It also has operations in Taiwan and Singapore.

Though certainly a good location from which to conquer Asian markets, Hong Kong, only a few hours from Canton, is even better for those whose eyes are riveted on the mainland. In the words of Hsu Hsung, deputy secretary of information for the Home Affairs Branch: "It's becoming increasingly clear to international businessmen that if they want to capture a part of China's market, Hong Kong is the place to be."

In fact, "U.S. companies often choose Hong Kong over Beijing," reports Peter Chase, a Hong Kong economic analyst with the U.S. State Department. "American firms are going to China and realizing that it is both expensive and difficult to set up shop in spite of inducements that have brought a more favorable climate for foreign investment there." China can't match Hong Kong's network of financial services, better standard of living, and its lack of bureaucratic red tape. Furthermore, if a company locates in Beijing, it has no choice but to rely on Chinese contacts. Hong Kong offers direct access not only to those Chinese but also to skilled personnel fluent in English and Chinese dialects who have hands-on China trade experience, Chase points out.

Not suprisingly then, trade between the U.S. and China through Hong Kong is flourishing. Re-export of U.S.-made goods through Hong Kong, of which roughly half were electronics-based, grew by 42.6% in 1983, to $202.5 million. Meanwhile, Chinese re-exports to the U.S. reached $757 million, up 54.2%, according to the latest data from the U.S. Department of Commerce. The improvement of transport and political links between Hong Kong and China and further liberalization of the Chinese economy should keep trade growing.

Whether exporting from the U.S. or from Hong Kong, U.S. electronics makers face direct sales opportunities in China second only to those in Japan. The Chinese government, whose stated plan's highest priority is the acquisition of Western technology, says it will spend $1 billion this year on high-tech imports. Purchases of U.S. computers, for example, doubled in 1984—to $101.2 million, from $50 million the year before—and are expected to double again this year.

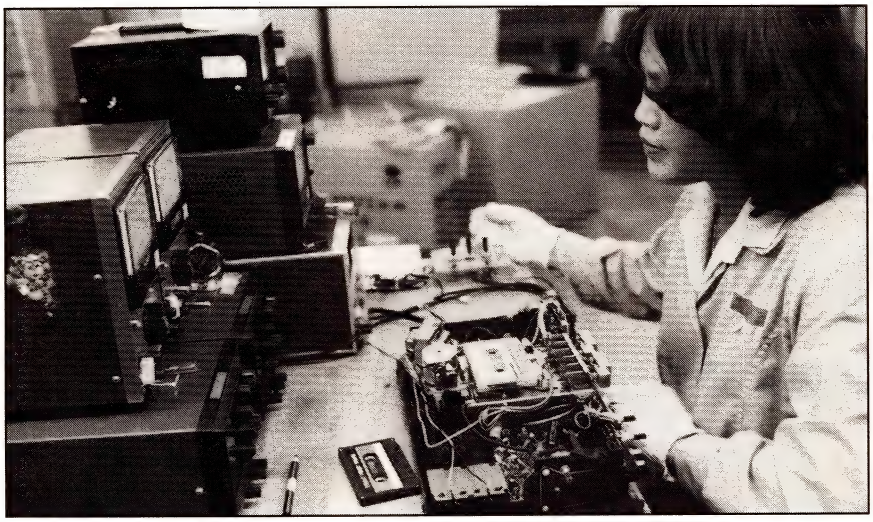
Hong Kong prides itself on being the paragon of free enterprise in action. The government has consistently maintained a policy of unfettered trade, free ports, low tax rates, and no foreign-exchange controls. The colony is renowned for excellent shipping and cargo-handling facilities as well as efficient banking and insurance systems. Those favorable attributes have made electronics the leading sector for overseas investment, accounting for 35.5% of the total, placed at $1.46 billion in 1984 by a government survey. The U.S. commands an overwhelming presence. With 43 wholly owned or joint-venture operations primarily for the assembly of electronic parts and components, it makes up 80% of the portfolio.

Nevertheless, there are still weaknesses. Like Singapore, Hong Kong's success in wooing foreign electronics companies has not sparked the growth of an indigenous industry capable of independent design, production, and marketing. Local producers fall into two categories: makers of radio equipment, Hong Kong's biggest electronics export, and manufacturers of so-called fad products such as electronic games, digital watches, and cordless telephones. "As soon as a consumer product appears to be in demand, a herd instinct develops and everyone charges in," explains W.R.A. Wyllie, a Hong Kong entrepreneur.

But assembly and fad-product manufacturing, in which designs are provided by foreign buyers and firms compete mainly on price, has deprived locals of the experience and know-how necessary for building support and service industries. According to the 1984 survey, a majority of foreign electronics companies believes that there are inadequate support facilities in Hong Kong and that the problem will restrict the colony's entry into many value-added markets, such as disk drives and printers, which require support of a precision-machining industry. Other weak links include dies and mold making, electroplating, heat treatment, die-casting, and forging.

Lacking both the resources and the incentives to develop original products, Hong Kong's spending on research and development is dismal. On the average, firms spend 0.24% of sales on R&D. There is one exception, however: the foreign-dominated components sector, which typically spends 3% of revenues to improve manufacturing processes.

Nevertheless, John Yaxley, director of industry, is not convinced that Hong Kong should embark on a massive R&D campaign, though he was one of the first to champion the idea of levying a tax on exports to finance such an effort. In any event, the idea proved too expensive and probably too sensitive for a government whose hands-off attitude is legendary. It was passed on to the publicly supported Hong Kong Productivity Council with the return suggestion that if the government thought such a program worthwhile, it should come up with ways to pay for it.



Let the good times roll. Hong Kong's government figures that its role in electronics should be to ease the way for firms that want to establish facilities, such as this assembly operation.

In a nutshell, that demonstrates the greatest difference in approach between Hong Kong and its Asian neighbors. In Japan, Taiwan, South Korea, and Singapore, the government has pursued high-tech development with a vengeance. Direct grants, low-interest loans, tax holidays, and protection from imports have enabled these countries to compete head-on with the U.S. and Europe in sophisticated electronics industries.

Hong Kong, by contrast, believes its job is to provide a fertile field, in the form of a basic infrastructure and low taxes, and let the private sector get on with business as usual. That has worked exceedingly well in attracting U.S. electronics investment, and the lure of China should keep it coming. At the same time, it could very well be Hong Kong's Achilles' heel—what has prevented the colony from gaining any comparative advantage with which to challenge the other three dragons, let alone the U.S. *–Reported by Robert Ethan*

THE ALL-DIGITAL PBXs STAKE THEIR CLAIM ON OFFICE AUTOMATION

by Robert Rosenberg

BUT MAKERS OF VOICE/DATA SYSTEMS FACE CHALLENGE FROM SEVERAL MANUFACTURERS OF LOCAL-AREA NETWORKS

An insurgent is lurking in the office telephone closet. The faithful old retainer, the analog private branch exchange long used simply to switch voice conversations, is quietly being replaced by all-digital switches that have powerful potential. These new PBXs will switch voice, but by taking over data-switching chores, too, they aim for the center of office automation. With the added functions of voice messaging and voice mail, they may well succeed.

That success is not ensured, however, unless manufacturers of all-digital PBXs overcome several obstacles. Fending off a challenge from several local-area-network manufacturers that are building networks optimized to handle voice and data may be the easiest task: these firms tend to be small startups without established customers. Another challenge is to shove the huge installed base of analog PBXs along the digital road.

But the biggest challenge to the digital PBX vendors will be to maintain internal unity while preparing for the integrated services digital network—the International Telegraph and Telephone Consultative Committee's plan to replace the worldwide analog telephone network with an all-digital network. ISDN proposes to give users access to a broad range of services through standard interfaces by providing end-to-end digital channels under the user's control. But when ISDN is mentioned to the digital PBX manufacturers, the uniform ranks start to crumble.

What's more, while plans for ISDN keep the future cloudy, the market for voice-data integration on the PBX is fraught with uncertainty. According to Dataquest Inc., the number of PBX lines shipped between 1980 and 1989 should more than double, from 2.6 million to 5.5 million, and revenues should follow suit, up from $2 billion to over $4.5 billion during the same period.

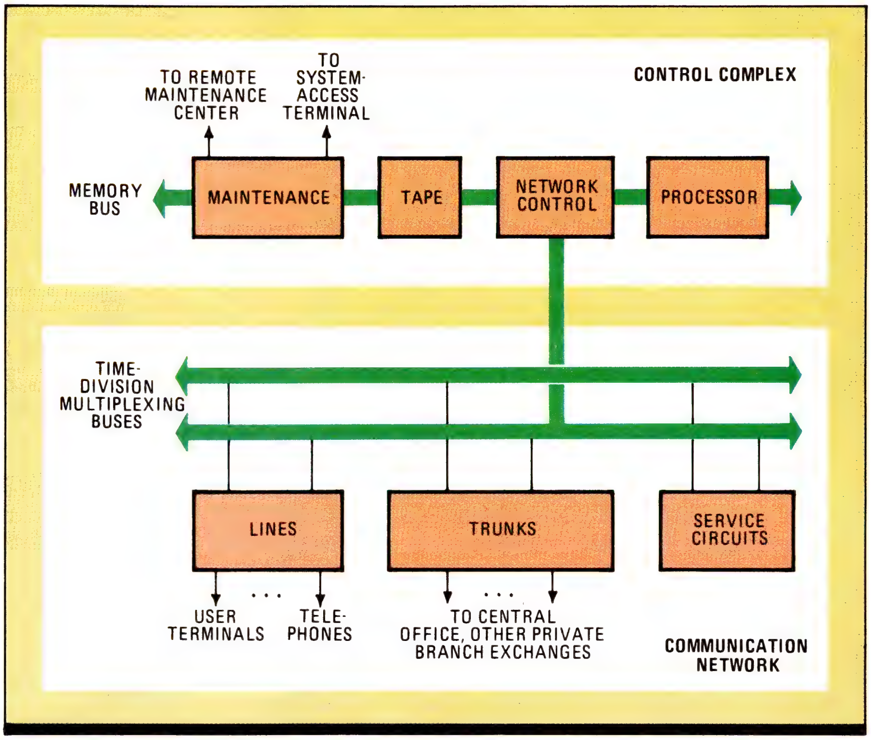
Although the PBX will play a larger role in the future, the amount of data integration is uncertain. Data lines may represent only a small portion of the total line growth, according to Greg Carlsted, an analyst in Dataquest's telecommunications group. "Out of a total of 3.8 million lines shipped in 1984, only about 84,000 were dedicated to data. So we don't anticipate that data penetration in the PBX market will burgeon—maybe it will represent 15% to 18% by 1989."

George Merrow, a telecommunications consultant with Advanced Resources Development, notes the same trend. "Systems that can integrate voice and data are selling well. But the lines integrating voice and data are not growing as fast."

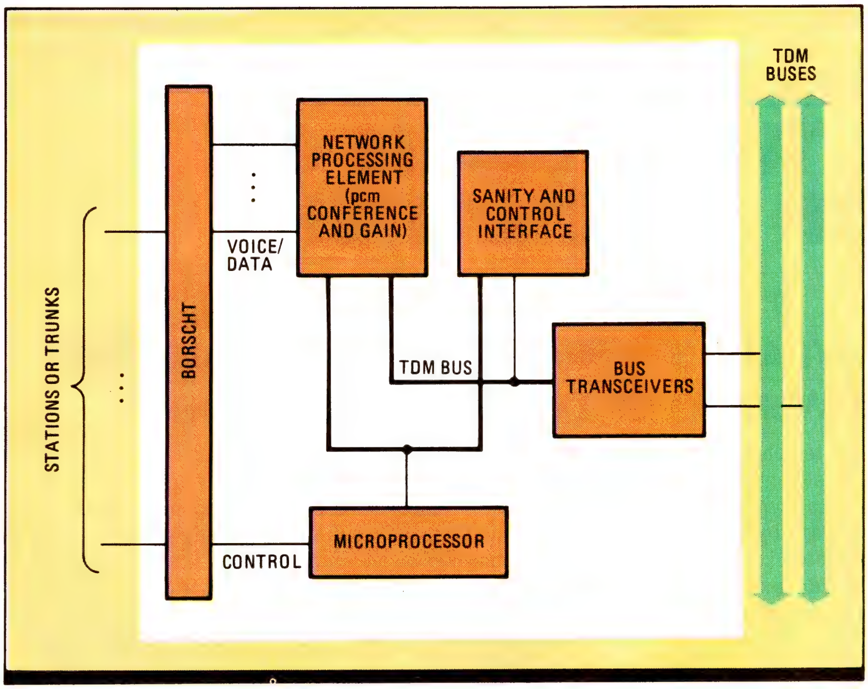
Since the PBX emerged from the telephone closet to become the switch at the center of the office, it has had to overcome some big disadvantages. The first switches that moved both voice and data, such as AT&T Co.'s Dimension PBX, which the company introduced in early 1975, were characterized by stored program control and an electronic switching matrix.

They were designed to handle the short-duration traffic characteristic of human conversation. When a data overlay in the form of a modem pool was added to these PBXs, data could be switched like voice, but only at speeds ranging from 110 to 2,400 baud—and at a penalty. The longer duration of the data traffic often blocked some incoming calls. It had no provision for error correction of data, and high-speed data communications were out of the question.

Improvements in the current crop of PBX designs have considerably eased voice and data integration chores. Spencer W. Rice, a telecommunications expert with S&R Consultants, Madison, N.J., says the newer PBXs have eight common attri-



1. Digital delight. A modern all-digital PBX architecture, AT&T's System 75's two parallel 2.048-MHz time-division multiplexing buses provide a 32-Mb/s transfer rate between the switches' control and port boards. The first five time slots on each bus act as the communications channel between the control complex and the 8031 microprocessors on each port card.



2. Generic port. On a generic port card, the System 75's bus transceiver pulls voice samples or data from the bus and hands off to the network-processing element. The sanity-and-control interface handles address recognition, buffering, and synchronization between the control channel and the port boards.

butes distinguishing them from voice-only PBXs:

- All have a digital switching matrix, and voice is pulse-code modulated.
- The switch is nonblocking, so that each station installed is ensured a time slot.
- Multiple processors (16 or 32 bits) handle all real-time call-processing requirements.
- Very large-scale-integration technology is used extensively in processors, memory, and line cards.
- The voice is digitized at the handset before it gets to the line card.
- Some speed, format, and protocol conversion is handled on the line card (or through a stand-alone converter).
- A high-level language is used for system control and applications.
- LAN functions are tightly coupled to the switch architecture.

Sharing such characteristics in varying degrees are NEC America's NEAX 2400, Intecom's IBX, Siemens's Saturn, and Harris's 20-20. "What separates these switches from their predecessors is that they were conceptualized and executed as voice and data switches from day one," says John Madrid, president of the Marketing Programs and Services Group, a telecommunications consulting firm. AT&T Information Systems' System 75 is working with architectural features common to the group but with an eye on the standards being developed for the worldwide all-digital ISDN network.

Typical arrangement

The System 75—introduced last April with 40 to 400 lines and aimed at medium-sized business systems—typifies the switching arrangement of many current-generation products. Two parallel 2.048-MHz time-division-multiplexing buses, each 8 bits wide with 256 time slots, provide a full 32-Mb/s transfer rate between the control complex of the switch and the port boards (Fig. 1). Separating the bandwidth into two distinct buses eases interface timing requirements and redundancy improves reliability, because the system can operate on only a single bus. The buses are printed on the backplane, and impedance is carefully controlled so they can be daisy-chained. A proprietary current-source bus transceiver permits hot-insertion and removal of port boards from the bus.

The control complex consists of an Intel 8086 microprocessor with on-board memory management and 256-K dynamic random-access memories with error-detection logic, arranged in 2-megabyte modules. Input/output functions have intelligent interfaces to offload processing from the microprocessor. The network control handles communications to the ports, and a tape interface is provided.

A control channel, created from the first five time slots on each bus, acts as the communications channel between the control complex and the 8031 microprocessors on each port card. At the direction of the network-control module, each processor (or group of processors) is polled. The first slot contains the port's address; the remaining four control data.

The port cards come in 14 flavors—satisfying such diverse requirements as analog-, digital-, and data-line circuits; central office, inward dial, DS-1/T-1 trunks; and specialized service requirements such as tone and clock generator, pooled modem, and speech synthesis. However, all share a common architecture (Fig. 2).

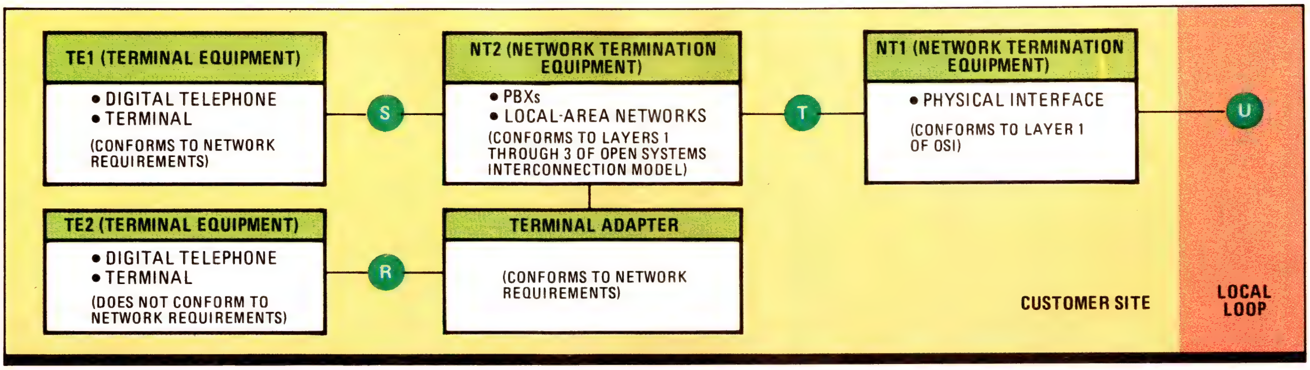
The typical digital-line port has eight lines—each supporting two 64-kb/s information channels and an 8-kb/s signaling channel. This arrangement is similar to one of the ISDN standards except that ISDN calls for a 16-kb/s signaling channel. "The digital communications protocol, which we developed four or five years ago, was our best approximation of what we though ISDN would be like," explains Paul R. Berkowitz, supervisor of circuit design for the System 75 at AT&T Information Systems. Changing the protocols to satisfy the ISDN specifications would be a minor adjustment, because "All our port cards have the intelligence to swallow ISDN when they are further defined."

The bus transceiver pulls either μ-law pcm (a-law in Europe) voice samples or data from the bus and hands off to the network-processing element, an 18,000-transistor VLSI chip. The network processing element handles four channels at a time, performing time-slot adjustments for listening or talking, gain adjustment, conferencing calling, and other features that require arithmetic processing of samples. The sanity-and-control interface takes care of address recognition, buffering, and synchronization between the system's control channel and the port card's microprocessor.

The microprocessor divides its responsibilites between port-specific and port-generic control signaling coming from the control channel. Borscht (battery feed, overvoltage, ringing, supervision, codec, hybrid, and testing) functions are fitted to the type of line or trunk interface.

Though the switching architectures in the current crop of digital PBXs have similarities, manufacturers disagree on how quickly the ISDN will mature. But they don't debate what it takes to survive. "If you want your company to stay viable, you just can't make it as a PBX-only vendor," says Rice of S&R Consultants. When firms such as Intecom team with Wang Laboratories and Rolm welcomes the IBM embrace, it shows that PBX manufacturers have learned that data switching is the key to survival.

"We'll send our people out with Wang salesmen if that's


TE1 (TERMINAL EQUIPMENT)
• DIGITAL TELEPHONE
• TERMINAL
(CONFORMS TO NETWORK REQUIREMENTS)
S
NT2 (NETWORK TERMINATION EQUIPMENT)
• PBXs
• LOCAL-AREA NETWORKS
(CONFORMS TO LAYERS 1 THROUGH 3 OF OPEN SYSTEMS INTERCONNECTION MODEL)
T
NT1 (NETWORK TERMINATION EQUIPMENT)
• PHYSICAL INTERFACE
(CONFORMS TO LAYER 1 OF OSI)
U
TE2 (TERMINAL EQUIPMENT)
• DIGITAL TELEPHONE
• TERMINAL
(DOES NOT CONFORM TO NETWORK REQUIREMENTS)
R
TERMINAL ADAPTER
(CONFORMS TO NETWORK REQUIREMENTS)
CUSTOMER SITE
LOCAL LOOP

3. ISDN interfaces. Making T or S the user's interface to the integrated services digital network will give suppliers entry to the customer site and a foot in the door to sell interconnection equipment, says a recent industry report. Major chip makers are supporting different proposals.

what a customer needs," says Intecom Inc.'s president, John Mullaney. Northern Telecom Inc. agrees. "We have an operating agreements with Sperry, DEC, DG, HP, and Wang," says David Coleman, a company representative. "This means we'll do pilot testing, then make joint customer visits."

One battlefield where competing PBX manufacturers and their computing allies collide is the development of a standard for a high-speed channel between PBXs and computers. Two proposals are being evaluated by the American National Standards Institute's T1D1 committee. The Computer-to-PBX Interface (CPI) is being championed by Northern Telecom and Digital Equipment Corp. Lining up in support are PBX manufacturers with a large installed base: Mitel, Rolm, American Telecommunications, Data General, and Prime.

Supporting cast

AT&T is offering the Digital-Multiplexed-Interface (DMI) with the support of chip makers Advanced Micro Devices, Intel, and Rockwell International. Intecom, Data General, and Wang Laboratories have said they will support both interfaces.

Both proposals have been shown to work. The System 75 connects to AT&T's 8.64-Mb/s packet-switching Information Systems Network using the CPI. In February, Northern Telecom announced a 40-Mb/s packet-transport facility connected to its popular SL switch using the CPI [*ElectronicsWeek*, Feb. 18, 1985, p. 20].

Although both interfaces provide a 1.544-Mb/s T-1 communications rate on two twisted-wire pairs between the PBX and the computer, the big differance is that the CPI keeps signaling in band, so the pipe divides into 24 synchronous channels that can carry 56 kb/s. This agrees with North American switching practices. The DMI proposes 23 data channels transmitting 64 kb/s and reserves a full 16-kb/s channel for signaling, which is proposed as an ISDN standard.

"The argument boils down to CPI proponents saying their interface is better because it exists and it's working," says Harvey A. Freeman, an expert in data communications with Architecture Technology Corp. "The DMI folks say that ISDN is moving along, so get ready for the future."

A CPI interface now costs about 50% less than a DMI PBX-to-host interface, according to Digital Equipment's estimates. So backers of CPI believe their design will beat the DMI in the early rounds of a standards battle. But this may change once VLSI compatible with ISDN becomes available.

"The issue here is that in order for this to be applied on a widespread basis and make economic sense, you need VLSI to get the cost down. So there are a lot of field trials going on with discrete implementations to prove out the concepts [of ISDN]. But until the VLSI hits the streets, the cost of building equipment will preclude widespread implementation. Once VLSI comes out, it is going to be a whole different ball game," explains Ronald R. Ruebusch, group product marketing manager of Advanced Micro Devices Inc.'s Information Products Division.

The CPI versus DMI argument is only one manifestation of the ISDN-interface standards debate. A larger, more important issue is the boundary between the user and the network. It is a battle for turf—who owns it and controls it. The T and S interfaces are identical—both support two B 64-kb/s voice and data channnels and a 16-kb/s signaling channel (Fig. 3). They are championed as interfaces to the network by AT&T and the European postal and telecommunications authorities, which means that the Network Termination Equipment (NT1 and NT2) at the customer site is part of the network, not customer-supplied equipment. "Such a policy would result in a PTT or a network supplier, instead of the customer, providing more of the equipment used in connection with ISDN," says a recent Electronic Industries Association report.

All the major chip makers are in the fray, lending support to one or another of the interface proposals. At a recent ISDN forum in Dallas [*ElectronicsWeek*, April 1, 1985, p. 16], AMD previewed two CMOS controller chips—the Am79C30 digital subscriber controller and the Am79C311 digital exchange controller—both aimed at the four-wire S interface. They will be offered during the second half of the year.

Motorola Inc. and others are looking at the U interface, still undefined by the CCITT. The U defines the interface to the network at the edge of the local loop, and PBX manufacturers may rally around it to preserve their turf.

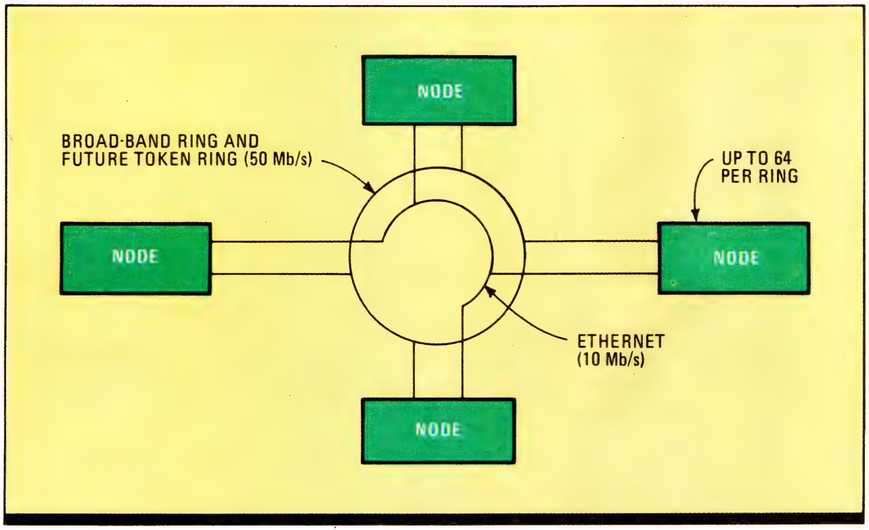
The evolution of ISDN will parallel that of LANs—with equipment suppliers supporting ISDN-compatibility but implementing their own low-cost or highly tailored custom interfaces, says Al Mouton, Motorola's MOS telecommunications marketing manager. Cost will make PBX manufacturers look for special interfaces that strip out extra ISDN overhead but still act as a gateway to the full ISDN network.

Motorola expects PBX suppliers to introduce proprietary interfaces to cut costs while giving higher bandwidth and speed—which may lock customers into proprietary interfaces. "I believe you are going to see the same kind of thing happen with ISDN as with the LANs," says Mouton. "You are going to have a standard out there that people can use, but you are also going to have a lot of options."

New models to come

The MC145422 and 145426 universal digital-loop transceivers are now available for 80-kb/s full-duplex communications over twisted-pair wires. A "2" model will be introduced in early 1986 for 160-kb/s user-definable transmission schemes. A "3" will also be offered that will use echo-canceling adaptive equalization for multiplexing over longer loop length.

Intel will pursue both two-wire U and a four-wire S interfaces with new CMOS chips. Intel's 29C53 will serve the standard S interface; the 29C55 will be used in the two-wire U interfaces. Mitel already sells the MT8975 and 8978 digital



4. Challengers. A new breed of local-area networks optimized for voice is battling it out with small private branch exchanges for market share. A leading contender, the Rose from CXC Corp., integrates a 50-Mb/s broadband ring with a 10-Mb/s Ethernet.

trunk circuits for ISDN-compatible communications. The firm also offers serial telecom digital circuits for U interfaces to ISDN systems and is developing a four-wire S transceiver.

Harris Corp.'s Semiconductor Sector is working on an U-like two-wire transceiver, the HC5590, expected to be introduced by early next year. National Semiconductor Corp. will introduce a two-wire U interface by the end of the year.

As the PBX manufacturers and their allies struggle to develop a blueprint for the future, small PBXs cum local-area networks are pushing the state of the art. "While it may be hard to say how successful the smaller manufacturers will be, it's clear that their approach to a voice/data switching architecture has been important to the market," explains consultant Merrow. These innovators are investing heavily in new VLSI to move both voice and data, but they are fighting uphill to develop a presence in the market, and their fate is uncertain.

For example, when Betsy Specht, an office manager for an insurance and investment firm in Boulder, Colo., learned last April that the firm supplying an integrated voice/data network to her company was going under, she was baffled. "I'm shocked—I absolutely love it," she said of the product. The company, Prolink Corp., stumbled; then it dropped from the race to bring a small integrated voice/data PBX to market. However, Prolink had a slick system that an office manager in a small business would find attractive. It combined more than 30 telephone functions with complete data-processing capability by packet-switching voice and data on a 10-Mb/s baseband ring.

"It was too far ahead of its time," explains John Hill, president of the Hill Partnership, a venture-capital company. "Also, they had too complex a tool, which was only 70% to 80% competitive on the individual pieces of the network."

Prolink may have been too early, with too much functionality, but right behind it have been others ready to take up the banner of voice and data integration. They too are finding the road slippery, however. Ztel Inc., founded in January 1981, promises its Private Network Exchange will fully integrate voice and data on an 802.5 token ring running at 4- and 16-Mb/s. Although the voice-only portion of the system is being shipped, full data integration has proved more elusive.

"Ztel's network capabilities are not even in alpha test," Merrow claims. "And it is not even saying it'll deliver till next year—and this is a key selling point!"

The CXC Corp., which bills itself as the builder of a fourth-generation business-communications system, has delivered a few systems. The Rose, introduced last May, tightly integrates a 50-Mb/s broadband ring with a 10-Mb/s Ethernet (Fig. 4). Only 33 Mb of the 50-Mb broadband channel is now used for circuit-switching both voice and data between nodes. The additional bandwidth is reserved for IEEE 802.5 and IBM Corp. token rings that will handle network control signaling and packet transmission.

Until the single-cable design can be put in place, the Ethernet acts as the control and packet channel. Later it will be joined to the ring by means of a gateway. Each ring can support up to 64 nodes, and up to eight rings can be joined by means of bridges. In addition, selected nodes in the ring can be designated as gateways to other networks.

CXC's desktop personal teleterminal includes such features as electronic and voice mail, conference calling of up to eight parties, speed dialing—about 200 features in all—in a 10-by-8¼-in. package with a single 80-character display.

The system's key element is the per-line switch—custom circuitry on the line card that acts as a mini-PBX by providing the bandwidth needed for either a voice or a data application (Fig. 5). For example, a frame from either a digital handset or terminal consists of a packet channel with synchronization and control information and two 64-kb/s B channels for voice or data. The per-line switch handles the switching requirements of the B channels dynamically in 8-kb chunks, up to 128 kb, as it simultaneously juggles the control information from the packet bus.

Because four of the switches are grouped into a single VLSI circuit, a 512-K data path can be built. Four of the VLSI circuits ganged on a single line card control 16 digital lines. The 16 lines can be configured to produce a 320- or 576-kb/s circuit switch from a single line card to the circuit on the other end of the twisted pair.

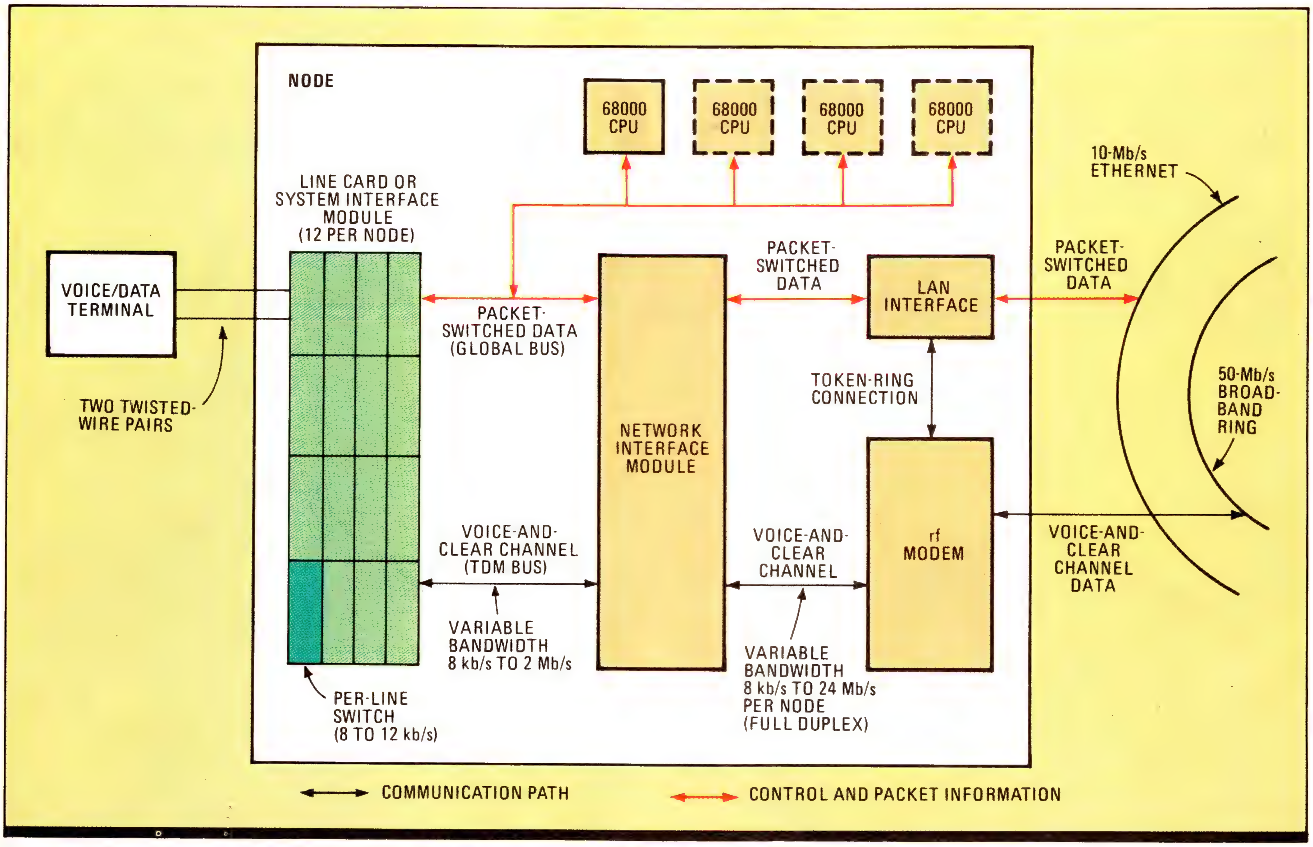
The line cards, called system-interface modules, connect to the network interface module in each node. The interface module, which acts as a connector to the Ethernet and broadband ring, determines whether the communications are intra- or internodal and assigns the necessary bandwidth within a single clock pulse.

Analog updates

If the voice-optimized local-area networks face an uphill battle to win user acceptance, moving the huge installed base of electronic PBXs into the digital world takes more momentum. Those firms with older electronic-switching PBXs aren't about to take them to the scrap heap—especially because voice and data can be brought closer in many ways. Strictly speaking, putting the LAN or a voice-mail system between the switch and the user is not integration, because there is no common switching matrix. But no one wants to abandon the huge installed analog base and the billions of dollars it represents while the world evolves an ISDN.

Analog switches represent a huge untapped market, says Luigi Mercurio, president of David Systems Inc. "In 1985, Centrex represented 42% of the total lines installed in the U.S. Most of these lines were installed after 1980 and have a book value of about $16 billion—so they should last 35 years."

The firm is aiming at the 100-line office with an attachment to the existing analog PBX, providing a means to bring both circuit- and packet-switched data through the twisted-wire pairs. Old rotary-dial handsets can stay on the desk, because voice switching is left to the host PBX. But when enhanced-


NODE
68000 CPU
68000 CPU
68000 CPU
68000 CPU
10-Mb/s ETHERNET
LINE CARD OR SYSTEM INTERFACE MODULE (12 PER NODE)
VOICE/DATA TERMINAL
PACKET-SWITCHED DATA
LAN INTERFACE
PACKET-SWITCHED DATA
PACKET-SWITCHED DATA (GLOBAL BUS)
TWO TWISTED-WIRE PAIRS
TOKEN-RING CONNECTION
50-Mb/s BROAD-BAND RING
NETWORK INTERFACE MODULE
VOICE-AND-CLEAR CHANNEL (TDM BUS)
VOICE-AND-CLEAR CHANNEL
rf MODEM
VOICE-AND-CLEAR CHANNEL DATA
VARIABLE BANDWIDTH 8 kb/s TO 2 Mb/s
VARIABLE BANDWIDTH 8 kb/s TO 24 Mb/s PER NODE (FULL DUPLEX)
PER-LINE SWITCH (8 TO 12 kb/s)
COMMUNICATION PATH
CONTROL AND PACKET INFORMATION

5. Networking voice. The key element in CXC Corp.'s line card is the the per-line switch—custom circuitry that handles the switching requirements of the B channels dynamically while juggling the control information from the packet bus. Each card controls up to 16 lines.

features handsets or data switching are required, the system manager comes into play.

On the backplane of the system manager is a 64-Mb/s time-division multiplexed bus that provides 512 64-kb/s time slots for switching voice between the system's digital handsets or between synchronous or asynchronous data terminals. An Ethernet-compatible 10-Mb/s packet bus can be connected by coaxial cable to the outside world or used with an internal 1-Mb/s packet-delivery system out to the desk. A 375-kb/s serial peripheral bus maintains coordination between the backplane and peripherals.

Davox Corp. is eyeing the same pie, but the firm is going after it by putting its 3274-type cluster controller between the PBX and mainframe. Using two twisted-wire pairs—one pair each for data and voice—it is bringing a 400-kb/s pipe out to the desk, which they also providing with an integrated voice-data terminal.

Another way to soup up a tired PBX is to give it voice-messaging capability. Octel Communications, San Jose, Calif., is delivering its Aspen voice-messaging systems—aimed at the Fortune 1,000 companies—to Centrex, Northern Telecom's SL1, and Mitel customers. By using a form of delta-modulation sampling at 32 kb/s, then compressing the pauses in the speech, the Aspen system can store 1 s of speech using 24 kb. VMX Inc. claims that its product has even lower storage requirements.

The VMX proprietary analog-to-digital converters give it an edge, says Johnny Davis, manager of product marketing. "The reason we got the storage rate so low is our sampling algorithm—we typically run at 16 kb/s of stored speech." A small four-port version of its Voice Message Exchange is available to original-equipment manufacturers. A 48-port system with plenty of voice-management capability can carry the load for larger systems.

Sydis Inc. has put a star-shaped 68000-based LAN between the user and the PBX, providing full network functions with voice-messaging capability. The network, which links up to 300 users, uses a single physical bus partitioned into two logical entities. They are a high-speed parallel carrier-sense multiple-access with collision detection message-passing bus and the time-division-multiplexing communications bus for voice and data switching—to communicate to the 68000-based processor boards organized as functional servers. These boards all have a 68010 processor with memory ranging from 512-K bytes to 3 megabytes, three interval timers, eight direct-memory-access channels, 16 full-duplex ports to the time-division-multiplexing bus, and virtual-circuit interface and datagram service to the CSMA/CD bus.

One board, designated a system master, allocates the slots on the time-division multiplexing bus and supports the applications by allocating them to a server. The applications boards manage basic service, on-line directory, and voice and text messaging. File-server processors connect with mass storage by means of a Shugart Associates Standard Interface peripherals bus. Through a custom voice processor implemented in advanced Schottky logic, the user can choose to store the entire ADPCM waveform or to compress it by as much as 4:1.

The message that LAN manufacturers such as Sydis and CXC are sending PBX vendors is that they want to compete for a share of the voice/data integration action. But counting the terminals with integrated handsets in an office will not reliably indicate the state of voice/data integration, because these firms tie the telephone and terminal together differently. The full-fledged digital PBX—which handles both voice and data in a common switching matrix—is the odds-on favorite to become the preeminent integration tool. Nonetheless, the token-ring LAN is clearly a serious contender. □

Additional reporting for this article was supplied by J. Robert Lineback, Dallas.

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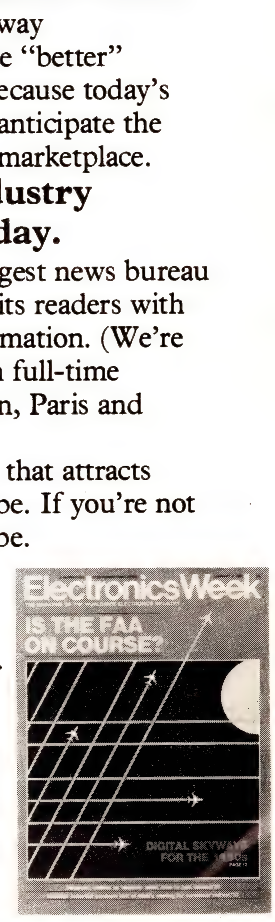


IBM PC AND INSTRUMENTS TACKLE DEVELOPMENT PROBLEMS

by Steve Zollo

Instrumentation based on the personal computer continues to be one of the fastest-growing segments of the electronics industry. The latest player in the field is Kontron Electronics. Kontron's line of personal-instrumentation systems, which are integrated with the IBM Corp. Personal Computer, PC/XT, or PC AT, are designed to serve engineers as complete microprocessor-development work stations that can include logic analyzers with speeds up to 500 MHz, interactive emulators, software-development tools, and design tools for programmable logic devices.

In this arena, Kontron faces stiff competition from the pioneer of personal instrumentation, Northwest Instrument Systems, and a dedicated newcomer, Hewlett-Packard Co. But Kontron's offering is superior to Northwest's because Kontron's logic analyzer is both a state and a timing machine, whereas Northwest's product is primarily a state machine, according to Rita Palanov, marketing manager for the product line. What's more, Kontron's machine has greater memory depth—up to 16-K on each of its channels.

As for the HP offering, Palanov says that the personal computer can control only one instrument at a time. With the Kontron setup, an engineer can run logic analysis and emulation tasks simultaneously.

"With one stroke, Kontron has brought the power of a full range of engineering instrumentation, including logic analysis and emulation, to the IBM PC environment," says Kontron's general manager Bob Cvitkovich.

The critical component in the Kontron system is the Kontron Personal Instrumentation (KPI) interface card that fits inside the PC, PC/XT, or PC AT. This dedicated instrumentation controller has its own on-board microprocessor and 256-K bytes of RAM plus parallel and serial interfaces that let it connect to all Kontron work-station instruments. The extra RAM on the KPI board will add to the computer's memory space when it's not being used for instrumentation tasks. The card essentially turns the PC into a machine based on CP/M, the operating system used by the logic analyzer and the emulator, says Palanov.

The IBM PC equipped with Kontron's KPI interface card and Kontron's interactive emulation system provides comprehensive, easy-to-use development software for the engineer. This covers communications software for programmer interface, terminal emulation, and file and program transfer; code converters with which the PC-hosted emulator can use Intel 8- and 16-bit hexidecimal and object codes, Tektronix hex, and Motorola 16-, 24-, and 32-bit S-Record code; and a full range of programs and utilities that support the on-board microprocessor in the 8086/8088 environment, including linkers, compilers, and assemblers for the most popular microprocessors.

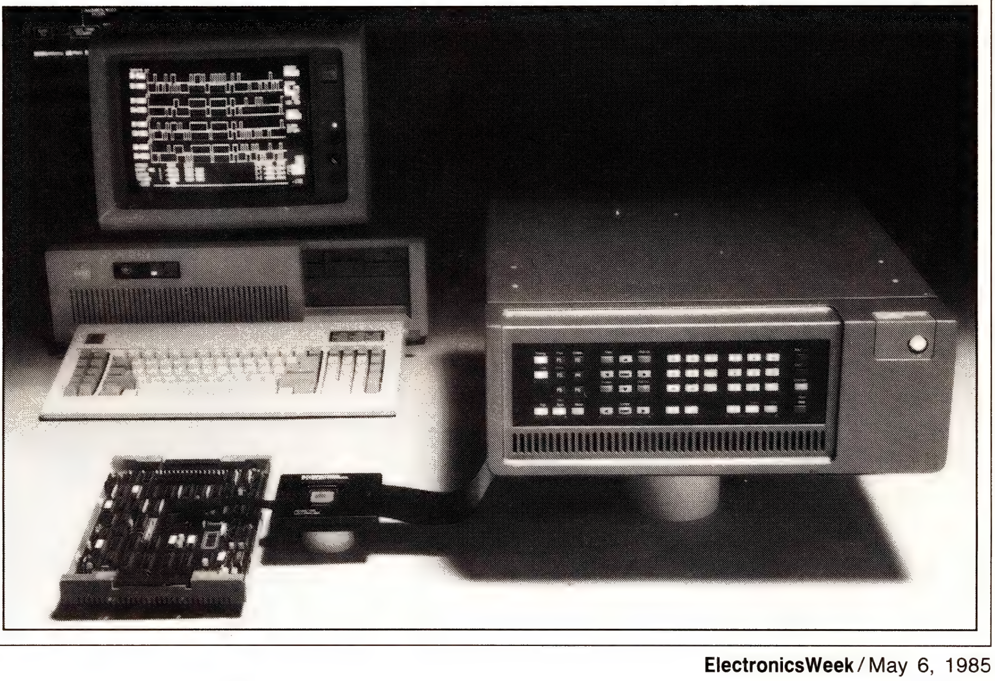
Its modular architecture makes Kontron Personal Instrumentation easily configurable on the IBM PC, says Cvitkovich. The PC-hosted Series III logic analyzer can be keyboard-configured for timing and/or state analysis in either the 8- or 16-bit worlds, or both; for mainframes; for bit-slice systems; or for other custom logic.

The Series III analyzer, when hosted by the PC, can have from 32 to 64 channels, each backed by up to 16-K of memory. Applications for the analyzer include trace and capture of intermittents; detection, triggering-on, and separate display of glitches; verification of software execution; performance analysis to create histograms of software execution time; simplification of basic measurements, using structured menus; and storage of setups and recorded data on the PC's disk.

In addition to hosting logic analysis and emulation, the PC can also crank out logic circuits. Kontron integrates programmable ROM and programmable-logic-device programming systems with the computer. With the Engineering PROM/PLD Programmer (model EPP-80), interfaced with the PC, the engineer can design both hardware and software on the PC, load it into the EPP-80, and program the appropriate device. The Manufacturing PROM/PLD Programmer/Service (MPP-80S) is, in essence, a ruggedized portable version of the EPP-80.

Kontron chose the Electro/85 show in New York to announce its new products and that it has been appointed an IBM Corp. value-added dealer; this means that Kontron can make internal changes to IBM's PC systems and still provide full warranties. The logic analyzer was designed by Kontron's German parent, Kontron GmbH; the emulator work was done in Kontron Electronics' Irvine, Calif., facility.

"We foresee a rapidly broadening range of personal-instrumentation work stations in the future," says Cvitkovich. Such future products include disassemblers for the Intel 80286 and



80186 microprocessors. The KPI card, which sells for $1,500, is available 30 days after ordering. The PC/XT and emulator combination sells for $13,920; the PC/XT and logic analyzer duo carries a $16,370 price tag.

Kontron Electronics, 630 Price Ave., Redwood City, Calif. 94063. Phone (415) 361-1012 [Circle reader service number 338]

File-transfer software moves data under MS-DOS

Binary and ASCII files can be transferred among users in a network of MS-DOS-based computers with Ptel, a universal binary file-transfer program. Running on IBM Corp. Personal Computers, XTs, ATs, and compatibles, Ptel will also upload and download files from electronic bulletin boards as well as move files among different operating systems and machines. Users can also move in and out of MS-DOS while on line.

Ptel includes complete Modem7 and XModem protocols with check sum or cyclic redundancy checking—the most popular binary protocols. In addition, Ptel features its own advanced binary protocol, Telink, which dynamically changes the block size during data transmission for fast file transfer. Operating in originate and answer mode, Ptel handles file transmission speeds of up to 9,600 baud and supports Bell 103, Bell 212A, and Racal Vadic protocols.

The software package requires 90-K bytes of memory and is priced at $195.

Phoenix Computer Products Corp., 1420 Providence Hwy., Suite 115, Norwood, Mass. 02062. Phone (617) 762-5030 [Circle 341]

Software lets users write programs for the K105 analyzer

Custom test procedures can be developed on an IBM Corp. Personal Computer, XT, AT, or compatibles with the K105 Smartpak, a software and hardware package that links a K105 logic analyzer to any one of these computers. Composed of a General-Purpose Interface Bus card and cable, three disks, and manuals, the K105 Smartpak lets test engineers write procedures using predefined logic-analyzer commands.

So that nonprogrammers can use the test software, help information is permanently displayed on the right-hand side of the screen. In addition, the manufacturer has designed in a programming interface called the Test Engineer's Control Software (TECS), which is specific to the K105. The control software consists of a library of predefined routines written in C language that eliminates the need for test engineers to write device-specific code.

The K105 Smartpak also provides Graphic Trace Control, so that an engineer can generate flow charts on the IBM PC with a triggering function—that is, they depict which data to capture as well as the conditions under which this data capture should occur.

The K105 Smartpak, which requires 512-K bytes of memory, will be available in August for $1,650.

Gould Inc., Design and Test Systems Division, 4650 Old Ironsides Dr., Santa Clara, Calif. 95054. Phone (800) 532-9320; in California, (800) 662-9231 [Circle 340]

C-language programs can be debugged before compilation

Software engineers are freed from waiting on time-consuming program compilation to find syntax errors by Smart/C, software that lets the user create, edit, test, and debug C-language programs before they are compiled.

Smart/C consists of the Environment, which provides syntax-directed editing and interpretation of the C source. It also includes the Migrator, which allows other C programs to be edited and debugged.

The software engineer can create a program within the Environment, invoke interpretation of that program, suspend interpretation, re-edit the program, and then resume interpretation at the point of suspension. This occurs without the operator having to load another tool or reload files being worked on.

The output of the Environment is a C-language ASCII file that is compatible with commercial C compilers. Smart/C runs on several computers, including the IBM Corp. Personal Computer, and under a variety of operating systems, including MS-DOS and Unix System V Release 2 and its relatives.

Prices start at $500 for Smart/C for an IBM PC running under MS-DOS and go to $10,000 for the Digital Equipment Corp. VAX-11/780 running under Ultrix. The price includes both the Environment and the Migrator. The software will be available at the end of May; delivery is in 30 days.

AGS Computers Inc., Advanced Products Division, 1139 Spruce Dr., Mountainside, N.J. 07092. Phone (201) 654-4321 [Circle 342]

Data-acquisition system captures 400,000 samples/s

The 7000-MDAS modular data-acquisition system makes it possible to capture analog and digital data on up to 64 channels (cascaded), with real-time multitasking and high-level communication with any attached host computer.

This system, which has processing and control capabilities, can achieve single-channel burst rates of 540 kHz and multiple-channel scan rates of 160 kHz. Analog data is converted and captured with resolution of 12 to 16 bits and rates up to 400,000 samples/s; a fast Fourier transform is performed on 1,024 data points in 1 s.

Communication takes place through two RS-232-C ports and an IEEE-488 interface bus for optional terminal or host control. However, the 7000-MDAS is itself a powerful computer, based on the 68000 microprocessor operating at 10 MHz. Weighing 12 lb, it can run as a stand-alone unit with its own operating system and optional high-level language (TBasic) plus 128-K to 512-K bytes of on-board dynamic RAM, real-time clock, display, and battery backup for remote operation.

Over 20 I/O modules can be directly connected to various sensors and transducers. I/O module types include differen-

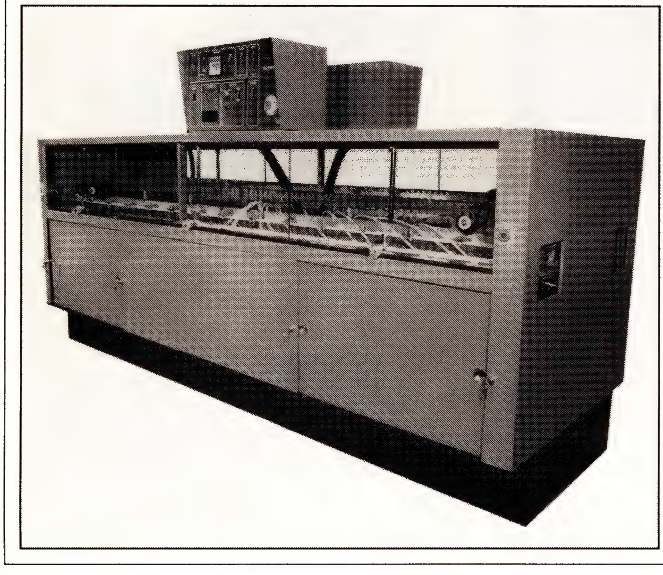
tial input, frequency and pulse measurement, bridge excitation and conditioning, and many others. Optional synchronized hold circuits for each I/O module allow simultaneous acquisition of scanned inputs. A complete four-channel system starts at $2,000. Numerous configurations are possible, and price and delivery (factory-direct, in two to four weeks) will depend on the user's requirements.

Transera Corp., 3707 N. Canyon Rd., Provo, Utah 84604.
Phone (801) 224-6550 [Circle 344]

In-line conveyor tins ICs with fast throughput

With the IC Tinning System, ICs can be tinned at a rate of from 0 to 30 ft/min per track. The modular system features a single-track in-line conveyor with manual load and unload; optional tube-to-tube automatic load and unload; and horizontal pushers (or fingers) that keep solder usage to a minimum.

Modules for wave fluxing, wave soldering, washing, and drying are included, and the standard single conveyor comes in widths of 300, 400, or 600 mils. Each track accepts a DIP of corresponding width; although throughput depends on DIP length and process considerations, the system can typically process two to three parts/s per track for 14-lead DIPs. The optional second track with process modules can be operated independently.



The manufacturer's wave-soldering nozzle design incorporates dual-chamber pumping, safety thermoswitch pump protection, wave-height control, and solder-temperature control. Process modules and utility intakes are interconnected with an electrical emergency stop to safeguard the operator, protect DIPs in process, and conserve power, air, and water.

Price and delivery time for the IC Tinning System will depend on the customer's requirements.

Electrovert USA Corp., P.O. Box 458, State Route 5 S., Camdenton, Mo. 65020. Phone (314) 346-3341 [Circle 345]

CPU card performs math operations

The math capability of the 6809 microprocessor is available to designers of STD-bus systems thanks to the 7809 multifunction CPU card, which has 40-K bytes of on-board memory and an RS-232-C asynchronous serial port. The 6809 can handle 8-by-8 unsigned multiply and 16-bit arithmetic operations.

With its five Joint Electron Device Engineering Council 28-pin standard memory sockets, the 7809 can accept up to 40-K bytes of on-board memory in combinations of 16- or 64-K RAMs and 16-, 32-, or 64-K EPROMs. Direct memory access to on-board memory facilitates data transfer.

When communicating with peripherals, the RS-232-C port with handshaking accommodates software-programmable baud rates from 50 baud to 19.2-K baud. The 7809 operates with other peripheral cards that generate Z80 mode-2 interrupts, using its interrupt vector-latch feature. Furthermore, the 7809 can be jumper-configured to meet the requirements of either data-communications equipment or data-terminal equipment applications. The serial port can also be programmed for terminal setup and modem control lines.

The 7809-1 card (1-MHz clock rate) is priced at $230, and the 7809-2 (2-MHz clock rate) is $240. Both are available now, with deliveries within three to four weeks.

Pro-Log Corp., 2411 Garden Rd., Monterey, Calif. 93940.
Phone (408) 372-4593 [Circle 347]

Caching is the secret of disk controller's efficiency

Caching architecture that achieves a data-transfer rate of 2.5 megabytes/s is the boast of the Rimfire 1200 controller. Rather than simply transferring the requested data to memory and then terminating the command, this caching disk controller continues to store succeeding sectors up to the limit of the cache. Then, if the next sector requested is already in the cache, there will be no disk latency.

To enhance throughput and improve overall system performance, the Rimfire 1200 offers such features as overlapped seeks, zero-latency track read, sector skewing, and sector slipping.

The Rimfire 1200 was designed to be compatible with systems based on AT&T Bell Laboratories' Unix operating system, and to this end it uses the scatter and gather commands: the scatter command reads contiguous sectors of data from the disk and stores them in widely scattered memory buffers, while the gather command retrieves these sectors.

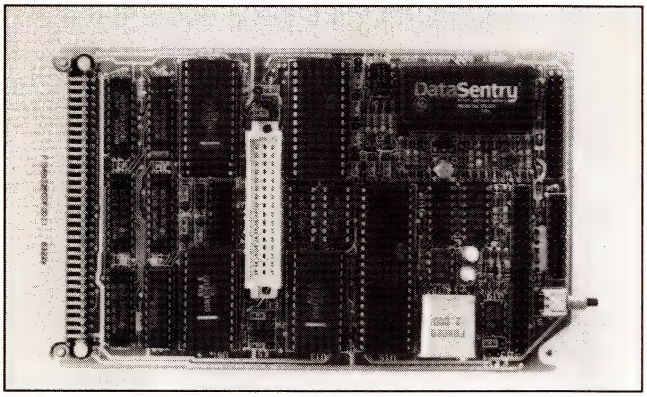
Supporting a Storage Module Drive, the Rimfire 1200 has built-in 48-bit error-correction coding, a feature the company claims is unique to Multibus Storage Module Drive controllers. For the systems integrator, the controller offers documented and supported drivers for Unix versions III, V, and Berkeley 4.2, as well as the iRMX86 operating system. Rimfire 1200, to be available in July, is priced at $2,195.

Ciprico Inc., 2405 Annapolis Lane, Plymouth, Minn. 55441.
Phone (612) 559-2034 [Circle 348]

Single-board computer speaks Forth language

An on-board Forth interpreter is featured on the RM65-1300NE, a single-board computer that can function as a stand-alone process controller. The single-board system includes the R65F11 single-chip microcomputer containing the Forth kernel, an RS-232-C serial port for connecting a terminal, and 16 I/O lines, 10 of which are routed to a second connector for a Centronics-compatible printer.

On its own, the module can function as a stand-alone industrial process-control board. With the addition of the R65FR1 ROM-development device plus a terminal, it becomes a complete software-development and -evaluation tool. A connector is provided for a floppy-disk-controller daughterboard to be added in the future.



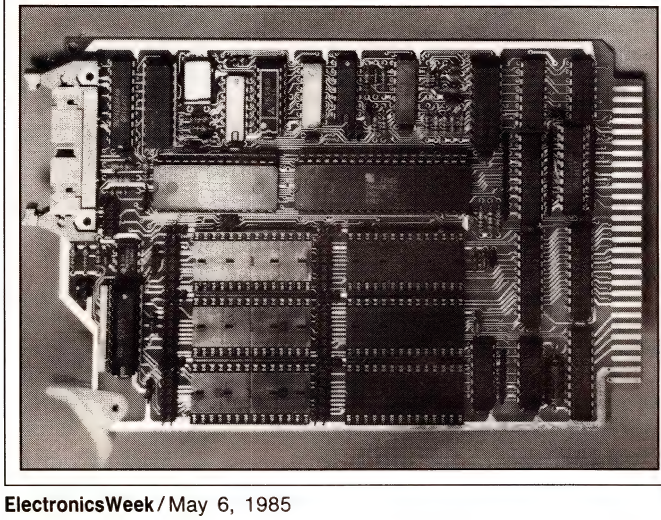
Designed on the RM65 bus, the Eurocard-sized module is compatible with a wide range of the manufacturer's other RM65 modules. With the Forth-kernel-encoded microcomputer and 6-K bytes of RAM, the RM65-1300NE single-board system is priced at $266, in 25-piece quantities. Delivery is from stock.

Dynatem, 19 Thomas St., Irvine, Calif. 92718.
Phone (714) 855-3235 [Circle 346]

CMOS CPU module can take the heat

The CMOS version of the CPU-2+, a Z80-based CPU module, has been released for use in high-temperature environments or in battery-powered systems. It is fully buffered for STD-bus TTL standards and has a typical power requirement of 275 mA.

The CPU-2+ is complemented by four separate counter/timer channels and can accommodate up to 96-K bytes of on-board 28-pin PROMs or RAMs. The programmable wait-state generator allows access to lower-speed EPROMs while maintaining high-speed RAM efficiency.



Other features of the CPU-2+ include processing speed to 4 MHz, direct-memory-access support, system reset, and clock generation. Ghostable (phantom) ROM—memory that, when a software switch is thrown, removes itself and becomes transparent to the system—is also supported.

In original-equipment-manufacturer quantities, the price of the CPU-2+ starts at $168, and delivery is from stock in 30 days.

Computer Dynamics Inc., 105 S. Main St., Greer, S.C. 29651.
Phone (803) 877-7471 [Circle 349]

Dumb terminals get smart with stepper controller

An RS-232-C terminal can control the input to a remote device for robotics or computer-aided manufacturing with the Stepper-1, a stepper controller that converts a dumb terminal into a pulse generator. The output is shown as a pulse train and directional signal on the terminal's screen.

Six English-language commands suffice to make the terminal smart using the Stepper-1, without requiring a programming language or special formatting. The frequency and number of pulses need be defined only once within any operation, and a sequence can be repeated using the repeat command. Multiple sequences can be tied together to extend the number of pulse steps.

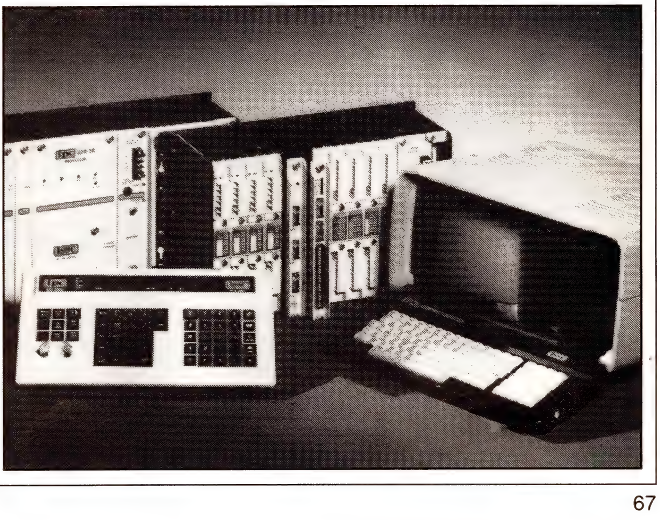
A working system consists of a terminal, an RS-232-C cable, and the Stepper-1 board. The Stepper-1 contains its own power source, which plugs into an 110-V ac, 60-Hz outlet. For one to nine pieces, prices begin at $249.95. Delivery time is up to four weeks.

Lynn Products Electronics, 400 Boston St., Lynn, Mass. 01905.
Phone (617) 593-2500 [Circle 351]

Single-axis system enhances programmable controller

Motion control has been added to the IPC 620 programmable controller line by the introduction of the IPC 622 single-axis control system. The IPC 622 SACS includes a servo-axis module, servo-control module, intelligent I/O rack, servo terminal, and menu-based servo-entry package. Its closed-loop feedback method continuously compares the actual to the programmed position, automatically controlling acceleration, deceleration, velocities, and stops.

A teach mode simplifies programming of the IPC 622 SACS, and two programming options are offered: the dedicated servo terminal provides keypads equipped with motion-control sym-



bols and displays the machine parameters entered by the operator. Alternatively, the servo-entry package lets the IPC 620 programmable controller's loader-terminal become the IPC 622's programming device.

Motion instructions and system parameters are stored in nonvolatile memory in the control module to minimize transfer time to and from the IPC 620 programmable controller; local information storage also frees more of the IPC 620's memory for other programming tasks.

Pricing depends upon configuration; a servo-axis module is $1,600; with a terminal, it is $4,500. Shipments will begin in mid-June and deliveries are expected to take four weeks.

Honeywell Inc., ISSC, 435 W. Philadelphia St., York, Pa. 17404. Phone (717) 848-1151 [Circle 350]

Sixteen motors connect with smart controller

Multiple-axis applications in robotics and automation are addressed by the MCU-2, an intelligent stepping-motor controller-driver that can control two four-phase stepping motors with currents up to 6 A per motor phase.

The MCU-2 provides high-speed indexing and speed controls, LED position display, manual position controls, and incremental encoder feedback input. Up to 16 motors (eight control-drive units) can be connected into a multiaxis system controlled by a host computer by means of a serial communication link: RS-232-C and RS-485 are standard communication interfaces on the MCU-2. Single-axis units as well as various configurations of multiple-axis systems are available, and quantity discounts apply.

The price depends on the customer's requirements. Delivery is from stock but may take up to eight weeks.

Advanced Control Systems Corp., 24 Teed Dr., Randolph, Mass. 02368. Phone (617) 963-4543 [Circle 352]

Wave-soldering system uses computer to boost throughput

Every aspect of pc-board soldering is individually monitored and controlled by the 700-CCS computer-based wave-soldering system. Functioning either as a stand-alone automatic system controlled by its resident computer, or a dependent system controlled through a data link by a remote processor, the 700-CCS is said to provide better throughput and higher yields than other types of soldering systems. Operators can key in any of the 1,000 predetermined pc-board design codes, and within 30 s the system is ready to produce production-sized quantities. Changeover from one board to another takes less than 1 min.

Flux density and height, solder temperature and wave height, conveyor speed, and topside board temperature are also monitored constantly by the system's computer. Maintenance is simplified because every major component can be accessed and removed for service if necessary, including the flux and flux-density module, ceramic infrared preheating module, the solder pot module and its automatic solder-level control system, and the conveyor rail system.

Pricing is available on request, with delivery taking from 12 to 16 weeks.

John Treiber Co., P.O. Box 3029, 7661 Windfield Dr., Huntington Beach, Calif. 92605. Phone (714) 841-6264 [Circle 357]

RAM's output-enable line prevents bus contention

Organized as 8,192 words by 8 bits, the CDM6264-3 CMOS static RAM has an address access time of 150 ns (maximum). It can match n-MOS dynamic RAMs for speed but consumes far less power—just 2 μA on standby.

Two chip-enable inputs are provided for turning off the address and output buffers to power down the chip. An output-enable line controls the output buffers to eliminate bus contention problems. The RAM needs no external clocks for operation, and all I/O signals are TTL compatible.

I/O signals travel over a set of eight lines, depending on the state of the chip's write enable: when low, the chip is in the write mode; when high, it is in the read mode.

Voltage levels between 4.5 V and 5.5 V power the chip, which operates in the 0°C to +70°C temperature range. In plastic DIPs, the CDM6264-3 costs $8.96 each when ordered in 5,000-piece quantities.

RCA Corp., Solid State Division, Route 202, Somerville, N.J. 08876. Phone (201) 685-7554 [Circle 358]

Mask-programmable CMOS ROM uses only 165 mW power

Using 2-μm technology, the MN231000, a 1-Mb mask-programmable CMOS ROM, is organized as 131,072 by 8 bits.

With an access time of 250 ns, the TTL-compatible ROM operates on only 165 mW when active. Standby requirements are 0.11 mW (CMOS input level) or 2.2 mW (TTL input level). The circuit has nonsynchronous, fully static operation and features three-state output for easier bus-line connection.

Delivery of engineering samples takes six weeks, because the circuits are made to customer specifications; delivery of production quantities requires an additional eight weeks. In original-equipment-manufacturer quantities, the MN231000 ROM sells for under $30.

Panasonic Industrial Co., Electronic Components Division, 1 Panasonic Way, Secaucus, N.J. 07094.
Phone (201) 392-4496 [Circle 360]

256-K EPROM boasts 170-ns access time

Designed to work together with the 80C86/80C88 microprocessors, 80C51/80C31 microcontrollers, and the company's peripheral components, the 27C256 erasable programmable ROM has an access time of 170 ns.

Pin-for-pin compatible with the manufacturer's 27256 HMOS EPROM, the 256-K EPROM uses Intel's CHMOS process for noise immunity and low power consumption. Active current is 10 mA; the standby mode requires 0.1 mA. The 27C256's low power requirements mean it can operate at a lower temperature, resulting in greater reliability.

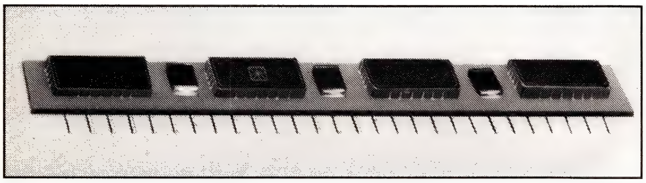
Programming support for the chip is available through the company's Fast 27K Module U2 upgrade of the iUP 200A/201A Universal PROM Programmer and the iPDS Personal Development System. Sample quantities are available now. In orders of 10,000 or more, each chip sells for $32.40.

Intel Corp., Literature Dept. W-208, 3065 Bowers Ave., Santa Clara, Calif. 95051. [Circle 361]

Static-RAM modules save space with single in-line packages

Providing a 4:1 space saving over monolithic circuits, two CMOS static-RAM modules pack four RAMs and decoupling capacitors into 28-pin single in-line packages.

The 81H256C is configured as 256-K by 1 bit; the 84H64C is organized as 64-K by 4 bits. Both use 5-V power supplies and, because they are fully static, require no clocks. Maximum power dissipation for the 81H256C is 825 mW; the 84H64C's maximum is 1.3 W. Both memory modules have separate data-in and data-out lines, and come with either 55- or 70-ns access times. A military-standard version of the 84H64C comes in a 400-mil-wide, 24-pin DIP.



Commercial versions sell for $385 in 100-piece quantities. Delivery takes 14 to 16 weeks after receipt of order.

Electronic Designs Inc., 35 South St., Hopkinton, Mass. 01748.
Phone (617) 435-9077 [Circle 359]

Ethernet board makes PC AT a high-performance server

Based on the same very large-scale integrated silicon transceiver chip, two network controllers and a transceiver are all designed for use in Ethernet systems.

The 3C101 transceiver connects controllers to IEEE-802.3 standard Ethernet local-area-network cables. The chip replaces more than half the components in the manufacturer's older transceivers.

Featuring its own on-board transceiver, one controller—the Etherlink 3C500B—connects IBM Corp. Personal Computers and compatibles to the company's Etherseries LAN, enabling users to share network resources. Also featuring an on-board transceiver, the Etherlink 3C505 acts as a high-performance board for server applications. With it, users can transform an IBM PC or PC AT into a network server.

The 3C505 has dual bus connectors with which the board can take full advantage of the PC AT's 16-bit I/O data path, but it can also operate with the 8-bit PC and PC/XT. The board includes Intel Corp.'s 80186 microprocessor and 82586 coprocessor and the transceiver chip (developed jointly by 3Com Corp., the manufacturer of these board-level products, and Advanced Micro Devices Inc.); it has 128-K bytes of RAM, expandable to 256-K bytes, and a programmable ROM.

All three products are available now. The 3C101 transceiver sells for $295, the 3C500 controller is $650, and the 3C505 server carries a $1,095 price tag.

3Com Corp., 1365 Shorebird Way, P.O. Box 7390, Mountain View, Calif. 94039. Phone (415) 961-9602 [Circle 367]

Desktop computer system uses dual-processor architecture

Dual microprocessors help to speed the Desktop Generation 45 computer through its tasks. Using the Desktop/UX operating system based on AT&T Bell Laboratories Unix System V, this multiuser system can support a wide range of peripherals, including terminals, printers, and storage units.

The dual-processor architecture means that the manufacturer's Microelipse processor can offload time-consuming I/O operations from the second microprocessor, a 32-bit Unix-dedicated 68000. Desktop Generation peripherals are supported by the Microelipse unit.

A basic model 45 system includes 512-K bytes of main memory, a 15-megabyte hard-disk drive, and a standard floppy-disk drive. A basic configuration can support up to eight users, and upgrades can provide up to 4 megabytes of main memory and 142 megabytes of disk storage.

Designed for original-equipment manufacturers and sophisticated end users, the model 45 carries an $11,845 price tag, plus $1,800 for software licensing. Delivery takes 90 days.

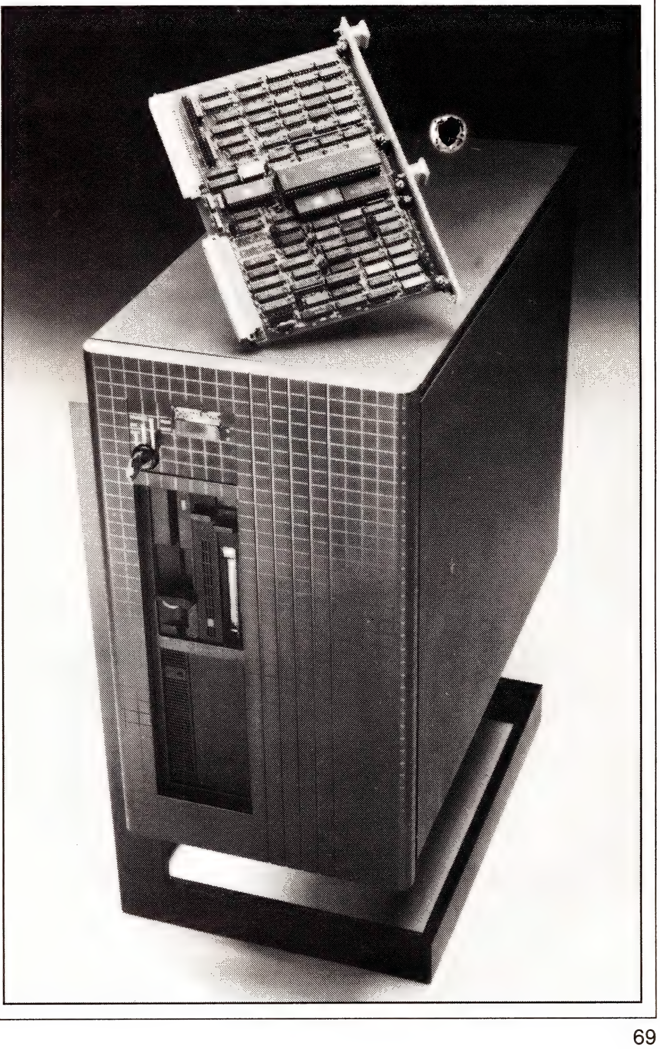
Data General Corp., Technical Products Division, 4400 Computer Dr., Westboro, Mass., 01580. Phone (617) 366-8911 [Circle 366]

VMEbus architecture toughens 32-bit computer

Thanks to its VMEbus architecture, the 32-bit Universe 2400 supermicrocomputer can operate in harsh surroundings such as factory floors, remote locations, or on ships.

Built around Motorola Inc.'s 12.5-MHz 68000 microprocessor, the computer's 32-bit data path and 4-K-byte cache execute 1.25 million instructions per second. High throughput is enhanced further by the system's 40-megabyte/s bandwidth and optional I/O processors, each with its own 68000. Software support is either UN/System V, the manufacturer's implementation of Unix System V, or UNOS, the company's Unix-compatible real-time operating system. The system can support from 4 to 64 users simultaneously.

A rugged chassis protects screw-mounted metal-edged VME boards that used DIN-standard gas-tight pin connectors



between boards and cables for better connections. Mountable in any of several configurations, the 10.5-by-17.5-by-21-in. computer weighs 65 lb and features tough plastic panels surrounding the metal enclosure. A trio of dual-speed fans cools the system, and the power supply is isolated from other components with its own fan to improve overall cooling.

Two models are available. The basic Universe 2402F comes with 512-K bytes of main memory (expandable to 10 megabytes), a 20-megabyte formatted Winchester disk drive, and a 320-K-byte floppy-disk drive; it sells for $9,999. The more powerful Universe 2403FT comes with 1 megabyte of main memory, a 35-megabyte Winchester disk drive, a 320-K-byte floppy-disk drive, and a 45-megabyte streaming-tape drive. It sells for $17,500. Delivery takes 90 days.

Charles River Data Systems Inc., 983 Concord St., Framingham, Mass. 01701. Phone (617) 626-1000 [Circle 365]

High-density storage frees computer-room floor space

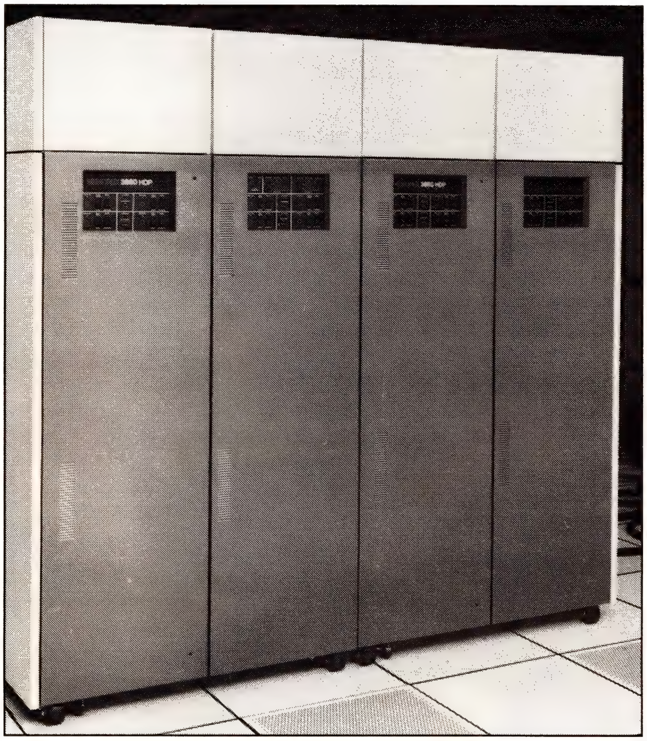
The 3680 HDP packs 10 gigabytes of storage into less than 26 ft² of floor space. This high-density-package disk storage subsystem contains eight 3680 head and disk assemblies. Because it has no side-access service requirements, units can sit side by side for efficient computer-room layouts. The subsystem needs just 15 in. of access space back and front.

Each of the eight head and disk assemblies has two independently addressable actuators, each of which has access to 630 megabytes of storage. No data conversion is required when migrating from the 3680 to the 3680 HDP. Average access time is 16 ms, and the 3680 HDP transfers data at a rate of 3 megabytes/s.

Standard features include thin-film read/write heads, 4-mm-thick substrate media, independent microprocessor for each actuator, and another microprocessor for maintenance diagnostics and environmental monitoring.

Shipments of the 3680 HDP will begin in the third quarter of 1985. It sells for $310,310; leasing is possible.

Memorex Corp., San Tomas at Central Expressway, Santa Clara, Calif. 95052. Phone (408) 987-1000 [Circle 354]



Ten-megabyte cartridge drives interface on IEEE-488 bus

Removable disk-cartridge Winchester drives, called TopSecret-1 and TopSecret-2, use the IEEE-488 bus to interface with all Hewlett-Packard Co. business and technical computers and create hard-disk backup. These subsystems feature a 10-megabyte removable cartridge disk and an optional 3½-in. floppy-disk drive.

The disk cartridges also serve for on-line storage. File directories may be organized by individual users, projects, libraries, or test programs. Disk space can be expanded by inserting new disk cartridges—with proper file arrangement, expansion is almost unlimited.

TopSecret-1 consists of a 5¼-in. Winchester disk-cartridge drive in a 4½-in. tabletop or rack-mountable enclosure, together with controller and power supply. The hard disk is usually formatted to a capacity of 10.4 megabytes (256 bytes per sector). With an average seek time of 85 ms, TopSecret-1 can sustain an average data-transfer rate on the IEEE-488 bus of 174-K bytes/s.

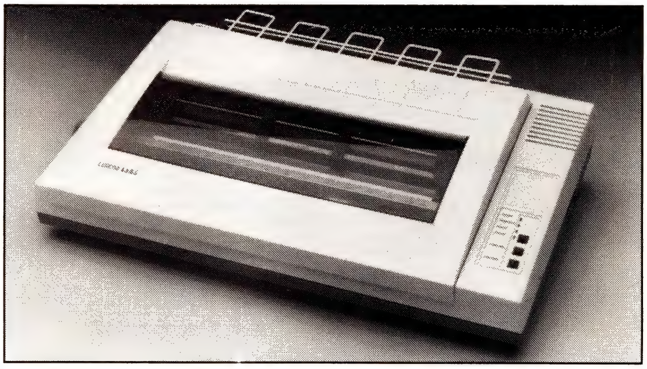
TopSecret-2 includes an additional 3½-in. floppy-disk drive. Because the floppy-disk drive reads and writes HP data formats, a complete system can be set up without the need for another external floppy-disk drive. Under HP microdisk formats of 256, 512, and 1,024 bytes per sector, formatted capacities of the floppy-disk drive are 630-, 710-, and 788-K bytes, respectively. The average seek time is 185 ms and the average data-transfer rate is 13-K bytes/s.

TopSecret-1 sells for $3,890, TopSecret-2 for $4,190. One removable disk cartridge costs $120. Delivery takes two to four weeks, and the firm gives volume discounts.

Bering Industries Inc., 1400 Fulton Pl., Fremont, Calif. 94539. Phone (415) 651-3300 [Circle 356]

Low-priced dot-matrix printer offers versatile font choices

Priced at $449, the Legend 1385 dot-matrix printer performs at the rate of 160 characters/s. It accepts continuous-form or single-sheet paper in widths from 4 to 15 in. and prints 136 columns of standard output or 233 columns of condensed type.



The Legend 1385 comes with over 40 fonts; in addition, the user can design special fonts with downloadable character sets. Proportionally spaced output is a standard feature. Its 2-K-byte buffer memory can be upgraded to 4-K bytes. Cal-Abco, Peripheral Products Division, 6041 Variel Ave., Woodland Hills, Calif. 91367. Phone (818) 704-9100 [Circle 355]

Integrated-speech keyboard has 160-word vocabulary

To free the operator's hands and eyes for other tasks, speech recognition has been integrated directly into the KB5152V keyboard. Plug-compatible with the IBM Corp. Personal Computer and PC/XT, the KB152V requires no software modifications and no adder board. It accepts a 160-word vocabulary and presents commands to the host as if they were key input.

The integrated keyboard comes with a noise-canceling microphone, foot switch, vocabulary-management software, and a user's manual. Integrated speech recognition can be incorporated into the manufacturer's custom keyboards as well. Available now for $1,495 retail, the KB152V carries a discount for quantity orders.

Key Tronic Corp., P.O. Box 14687, Spokane, Wash. 99214. Phone (800) 262-6006 (in Washington, phone (509) 928-8000) [Circle 353]

Gate array offers 800-ps speed in high-radiation environments

The HM1000R radiation-hardened gate array has demonstrated internal gate speeds of 800 ps while consuming less than 2 W of power.

Designed for airborne and ground-based military applications requiring high radiation tolerance, the array offers the equivalent of 1,000 TTL gates. The HM1000R is based on a 4-μm junction-isolated advanced digital bipolar process and combines internal current-mode logic with ECL 10K and large-scale TTL I/O cells.

The neutron hardness level is 3E14 neutrons/cm^2, a level unattainable by conventional gate-array processing

BEST SUITED FOR MICROCOMPUTER

It's BEAD INDUCTOR that perfectly suppresses noise.

●BL01 Series (Axial type) added to BL02 Series (Radial type) suffices auto components insertion. ●Reduces total cost. ●Best suited for inhibitting noise from microcomputers and vibration from high frequency amplifier circuit.

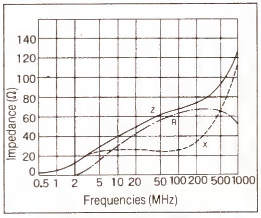
■Applications

FM tuners, TV sets, VTRs, stereo sets, and radio-cassette recorders.

■Electrical characteristics

- ● Permeability(μi):550
- ● Saturation Magnetic(Bs):3100(gauss)
- ● Residual Magnetic Flux Density(Brs):600(gauss)
- ● Coercive Force(Hc):0.3(Oe)
- ● Curie Point(Tc):130(℃)
- ● Temp. Coefficient($\alpha\mu$r):20×10^{-6}
- ● Relative Loss Factor(DF/μi):13×10^{-6} 0.5(MHz)
- ● Resistivity(μ):10^7 (Ω-cm)

■Freq. char. (BL02RN-R62)



BEAD INDUCTOR

In addition, Murata provides thru-type and disc-type, block-type and AC line noise filters, the filter-incorporated connectors.

For further information, contact:

muRata ERIE

MURATA ERIE NORTH AMERICA, INC. Phone:404-953-1799 Telex:542329
3002 Kingston Court, S.E., Marietta, GA 30067, U.S.A.
MURATA ERIE ELEKTRONIK GMBH (West Germany) Phone:0911-66870 Telex:623763
Kreuzsteinstr, 1A D-8500 Nürnberg 52, West Germany
MURATA ERIE ELECTRONIQUE S.A. (France) Phone:024-6767 Telex:699954
MURATA ERIE ELETTRONICA S.R.L. (Italy) Phone:688-4833 Telex:330385
MURATA ERIE ELECTRONICS (UK) LTD. (England) Phone:2514-28585 Telex:858971

muRata
MURATA MFG. CO., LTD.

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MURATA ELECTRONICS SINGAPORE (PTE.) LTD. (Singapore) Phone:2554233 Telex:21127
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(Taipei Office) Phone:02-562-4218
MURATA COMPANY, LTD. (Hong Kong) Phone:0-262099 Telex:56208
MURATA MFG. CO., LTD. Seoul Branch (Korea) Phone:720-7605/720-7321 Telex:25858

Circle 80 on reader service card

methods. The total dose-hardness capability is 1E7 rads (Si)—well above the levels provided by the newest oxide-isolated processes.

Eighty- and 64-pin leaded chip packages are available for the HM1000R. A nonrecurring engineering charge for the custom design is about $80,000 and includes 10 working samples. Typical turnaround time, from schematic entry to first prototype, is 16 weeks. Orders are now being accepted.

Honeywell Inc., Digital Product Center, 1150 Cheyenne Mountain Blvd., Colorado Springs, Colo. 80906.
Phone (303) 577-1049 [Circle 362]

Microcomputer chip has EPROM for faster software development

Two single-chip CMOS microcomputers feature instruction sets that are upwardly compatible with Hitachi Ltd.'s HD6805 family of microcomputers. The two parts—HD6305VOP and HD63705VOC—are available in 1-, 1.5-, and 2-MHz versions.

The microcomputers are identical with respect to function, pin assignment, and electrical characteristics. The difference is that the HD6305VOP has a 4-K-byte mask-programmable ROM, while the HD63705VOC features a 4-K-byte EPROM. With the erasable programmable version, original-equipment manufacturers can rapidly develop software for pilot production, saving time between the design and shipment of products that use the nonprogrammable microcomputer chip.

The chips are designed for low-end to midrange applications requiring low power but high speed, such as electronic keyboards and floppy-disk drives, and they offer instruction execution times of 0.5 ms. Each chip includes a CPU, a 192-byte RAM, an 8-bit timer with a 7-bit prescaler, a 15-bit timer that can be used as a clock divider for serial communications interface, a clocked synchronous serial-communications interface, and 31 I/O ports that provide simple system exapansion.

The HD630RVOP (with the mask-programmable ROM) comes in a 40-pin standard plastic DIP or a 54-pin flat plastic package; in quantities of 5,000, it is unit-priced at $7. The EPROM version, the HD63705VOC, comes in a 40-pin ceramic package with a window for erasing with ultraviolet light. Samples of the EPROM version, which uses a 12.5-V programming voltage, go for $59.40. Samples of both will be available in June, but production shipments will not begin until July.

Hitachi America Ltd., Semiconductor and IC Division, 2210 O'Toole Ave., San Jose, Calif. 93131.
Phone (408) 942-1500 [Circle 363]

600-MHz ECL gate array offers on-chip TTL circuit interfaces

Operating at a system clock frequency of 600 MHz, the FGE2500 ECL gate array is the fastest commercially available silicon-based gate array, its manufacturer says. The chip, which offers mixable ECL and TTL I/O, has 2,840 equivalent gates.

On-chip interfacing with TTL circuits eliminates the need for separate converters in mixed-logic systems, which can take up valuable board space and degrade performance and reliability. The FGE2500 has 120 signal pins, 64 of which provide output or I/O functions; 252 internal cells are on chip.

The typical macrocell propagation delay is 225 ps, making the chip suitable for applications in mainframe and superminicomputers as well as military and aerospace systems. Speed/power options permit designers to maximize performance by individually assigning the macrocell's functional switching speed and drive current for each output. Current can vary between 0.25 mA at low speed and 1 mA at high speed.

The speed-power feature is programmable by computer-aided design systems. Design can be performed with the company's Faircad interactive design system at any of several centers in the U.S., the UK, and Japan, or with special software packages written for Daisy or Mentor engineering work stations.

The chip is available now; price depends on such variables as design complexity and order size. Other members of the family include 680- and 2,500-gate arrays.

Fairchild Camera & Instrument Corp., Gate Array Division, 1801 McCarthy Blvd., Milpitas, Calif. 95035.
Phone (408) 942-2672 [Circle 364]

1,300-nm optical test set has dynamic range of 15 dB

Designed for use on both single- and multimode optical-fiber cable, the model 213 optical time-domain reflectometer measures splice and fiber losses with a dynamic one-way range of over 15 dB on single-mode and 22.5 dB on multimode cable. The 1,300-nm test set operates from internal rechargeable batteries or from external ac or dc sources.

The test set, which features simplified controls, uses a rugged, optical cable connector; when connecting to bare fiber, this connector eliminates polishing and troublesome alignment procedures, minimizing testing time. On terminated systems, fibers may be connected by optional pigtail adapter cables.

The test set weighs 16½ lb with batteries and includes a fiber termination kit and padded carrying case with a sun and rain shield. Priced at $24,880 including the batteries, the model 213 is available from stock.

Biddle Instruments, 510 Township Line Rd., Blue Bell, Pa. 19422.
Phone (215) 646-9200 [Circle 371]

Calibrator displays errors within 0.1% deviation

A programmable oscilloscope calibrator, the model 6127B delivers the test signals required either from its smart front panel or as the principal stimulus component in a computer-controlled test system using the IEEE-488 interface bus. The company claims that the number of voltage, current, and frequency ranges are unprecedented for this type of calibration instrument.

For example, with an auto-step feature, the operator can step through internal calibrator settings. There is a 1-MHz repetition rate on the 200-ps fast rise pulse; a 50-Ω termination, when required, is automatically connected across the scope input; and a software-activated filter removes broadband noise from the test signal.

The model 6127B can read oscilloscope scope calibration errors directly and display them within 0.1% deviation without the need for counting CRT graticule marks and making any additional calculations.

Two accessory output heads come with the calibrator. The 61271C fast pulse/time and amplitude accessory head launches all the test signals used to check the vertical, horizontal, and timing functions of the scope as well as checks the probe. The 61272A amplitude comparator head is used to verify that the instrument's internal amplitude calibration signal (that most scopes have for self-checking purposes) is accurately calibrated.

Available from stock, the 6127B sells for $12,575.

Ballantine Laboratories Inc., P.O. Box 97, Boonton, N.J. 07005.
Phone (201) 335-0900 [Circle 370]

Fiber-optic test set works in laboratories

Combining a feedback-stabilized source with an accurate power-measurement system, the T500 tests the attenuation of fiber-optic connectors, splices, and jumper cables. The instrument is suitable for laboratory evaluation of fiber-optic components and testing cable assemblies in manufacturing.

The T500 can work with any 4½-digit voltmeter for readout resolution of 0.01 dB, or it can be used with a computer-based data-acquisition system for automatic testing. Various source wavelengths and fiber types can be accommodated by different models of the T500. Long or short wavelength sources for single- or multimode fibers are available.

Priced at $2,750 for the short-wave version, the T500 offers dynamic ranges of up to 60 dB for short wavelength, 35 dB for long-wavelength multimode, and 25 dB for long-wavelength single-mode measurements. The T500 is available in four to six weeks. The long-wave model goes for $3,950.

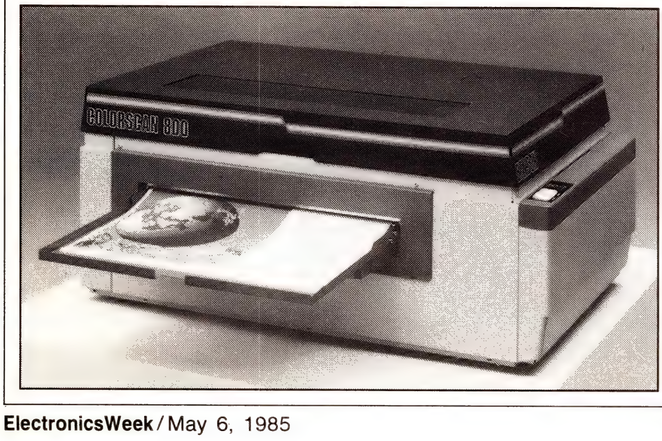
Fotec Inc., 529 Main St., Boston, Mass. 02129.
Phone (617) 241-7810 [Circle 372]

Full-color plotting system can complete a plot in 5 min

Up to four work stations can share the Color Imaging System, a full-color, high-resolution, ink-jet plotting system that reproduces computer-screen images with full pixel-for-pixel resolution.

Combining the manufacturer's table-top Colorscan 800 ink-jet color plotter with its Color Image Processor, the system can complete a plot within 5 min. Resolution is 41,209 dots/in.^{2}, and ink delivery is controlled by an electrical signal through the Colorscan's ink head.

Selectable black/white field reversal, a limited color mode, and accentuated black are all featured. In addition, the system provides automatic media loading, plot ejection, and a control panel that warns users of system malfunctions and low supply levels. The need for graphics software, device drivers, communications equipment, and rasterizing controllers is eliminated; plots are performed with a single keystroke.



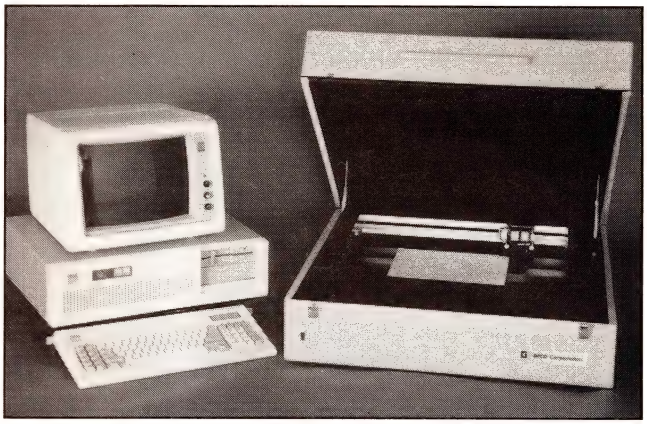
Users need not waste computer time while the plot is being made. Hooked directly to the work station over analog cables, the system offloads from the on-screen image by freezing it for about two seconds and then freeing the terminal and the user to go to the next task. Delivery of the system, which goes for less than $25,000, takes 30 days.

Benson Inc., 2690 Orchard Park Way, P.O. Box 32059, San Jose, Calif. 95152. Phone (408) 945-1000 [Circle 377]

Photoplotter is designed for pc-board CAD systems

Accommodating plots of up to 15.5 by 21.5 in., the FP1-1622 photoplotter is designed for use with microcomputer-based pc-board computer-aided-design systems.

Simple to install and operate, it can generate quality work with one-to-one precision and line width and spacing as fine as 12 mils. Its flat-bed plot area features vacuum hold-down. Software support for the FP1-1622 comes from the producers of PC-Cards, a CAD program for designing pc boards.



Priced at $25,000, the FP1-1622 can be delivered 90 days after receipt of order.

GTCO Corp., 1055 First St., Rockville, Md. 20850.
Phone (301) 279-9550 [Circle 376]

Two chips offer communications features for compact systems

With just two chips, the original-equipment manufacturer can integrate data communications, including modem capabilities and other features, into a variety of compact systems.

Full-duplex, 300-, and 1,200-bits/s data communications are possible without additional components or external control. The MP212A Plus has all the required modem hardware and performs dialing, call monitoring, and data-access arrangement. Besides modem operations, the unit can perform dual-tone multifrequency generation and call-progress-tone detection. A universal asynchronous receiver transmitter and timing sequences for automatic handshaking are included with the system.

Designed for compact systems, such as portable and lap-type computers, the two-chip set needs only 300 mW to operate and is powered by 5-V sources. The only additional circuitry needed is the Federal Communications Commission data-access arrangement for connecting it to telephone lines. One chip, the MP7246, has all the circuitry needed for a microprocessor or RS-232-C interface, plus a UART, 300- and 1,200-b/s modulators, a scrambler and descrambler, and the complete logic for modem handshaking and loop tests.

The other IC, the MP7247, contains the filters, line equalizers, amplifier, tone generators, tone detector, digital automatic gain control, carrier detector, and system clock. If a different filter or equalization network is desired, the chip offers the flexibility for an alternative network to be added.

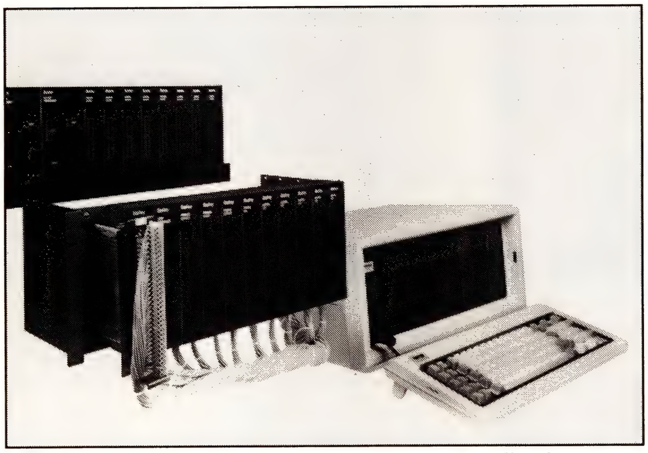
Samples, data sheets, applications boards, and applications support are all available; production quantities take six weeks for delivery. The two-chip set sells for $65 to $75 in 1,000-piece quantities, depending on the interface.

Micro Power Systems Inc., 3100 Alfred St., Santa Clara, Calif. 95054. Phone (408) 727-5350 [Circle 369]

Controllers can be linked to add I/O points or redundancy

A compact, digital programmable controller, the Bailey PC-90 uses a processor that allows each unit to accept up to 1,000 digital or 384 analog I/O points. A peer-to-peer communication structure allows additional processors to communicate with one another without direct cabling, expanding the PC-90's ability to control tens of thousands of points.

What's more, for security, redundant processors and I/O modules can be added to maintain operation without interruption. The PC-90 can be programmed using a Compaq personal computer. Its ladder-diagram format can easily incorporate modulating control. Annotations of contacts, application notes, and cross-references are provided by a concise documentation package.



Because the PC-90 is compatible with the company's Network 90 distributed control system, a custom gateway or expensive hard-wiring are not required to link programmable controllers with the process control system. For a complete factory-automation system, all elements can be linked with a plant communications highway through standard Network 90 interface gear. If desired, color CRTs may also be added for monitoring and control. Each system is custom tailored, so price and delivery vary according to configuration.

Bailey Controls, 29801 Euclid Ave., Wickliffe, Ohio 44092.
Phone (216) 585-6818 [Circle 375]

MOS FETs handle high voltage, have reduced on-resistance

A series of n-MOS FETs, designed for such applications as motor controls and switching power supplies, handles from 350 V to 500 V and from 4.5 A to 15 A.

Using proprietary field termination for isolation around the edge of the chip and minimal cell density, the enhancement-mode devices have high-voltage characteristics with reduced on-resistance. The MOS FETs come in both plastic TO-220 packages that can withstand temperatures from −55°C to +150°C as well as in metal TO-204AA/AE packages that offer the same resistance to cold but remain operable in temperatures up to +175°C.

The series fully matches the specifications of 56 popular industry part numbers, the company says. Prices for orders of 100 units range from $2 for 400-V 5.5-A models up to $37.90 for 500-V 15-A components. The series also includes a wide range of intermediate designs. All units are available now.

Fairchild Camera & Instrument Corp., Power Systems Division, 4300 Redwood Hwy., San Rafael, Calif. 94903.
Phone (415) 499-4406 [Circle 373]

Monolithic amplifier comes in commercial, military versions

The single-chip HA-2542 wideband operational amplifier puts out a ±100-mA current at a 350-V/µs slew rate. The company says the op amp eliminates the need for hybrids and buffer devices.

With a 5.5-MHz full-power bandwidth, the amplifier is suitable for high-frequency signal-conditioning circuits, coaxial-cable driver circuits, and pulse-and-video amplifiers. The part comes in three versions—a commercial-grade 14-lead plastic DIP, a commercial-grade 14-lead ceramic DIP, and a military-grade 12-pin TO-8 metal can.

In quantities of 100, the plastic DIP sells for $6.30 each; the ceramic DIP sells for $7, and the military version sells for $28. Samples are available now, but production quantities require 12 weeks for delivery.

Harris Corp., Melbourne, Fla. 32919.
Phone (305) 727-9100 [Circle 374]

Microwave test set runs in field or laboratory

A noise-and-interference test set simulates radio-link performance during flat-fade and interference conditions. The HP 3708A is designed for operation in the intermediate-frequency section of a digital or FM microwave radio. By adding calibrated levels of white noise or interference signals to the carrier wave, the test set maintains an operator-selected carrier-to-noise (C/N) or carrier-to-interference (C/I) ratio.

With the built-in i-f power meter and microprocessor control, the operator can sample the radio i-f carrier power continuously at the point of noise or interference-signal injection. The signal level adjusts automatically to maintain a constant C/N or C/I ratio, even in the presence of variations in the receiver-carrier level.

Though the HP 3708A is aimed primarily at manufacturers and operators of microwave-radio systems, option 001 converts it into a general-purpose i-f noise source and power meter for any microwave laboratory. This version of the instrument, which has 50-Ω interfaces, adds $160 to the HP 3708A's $13,400 base price. Delivery is approximately 26 weeks after receipt of order.

Hewlett-Packard Co., Inquiries Manager, 1820 Embarcadero Rd., Palo Alto, Calif. 94303 [Circle 378]

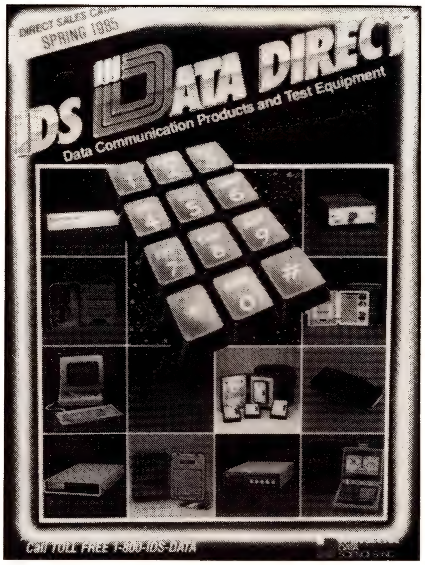
Controlling interest. Three product sheets cover the LSI-11 and Microvax Q-bus-compatible controllers, which are available as board-level products, either as subsystems integrated with peripherals or as fully integrated systems. Each sheet details features and engineering specifications. Request the following literature by number from General Robotics Corp. at (414) 673-6800: MWV22, "Winchester Disk Controller"; DHV11, "64-Port Asynchronous Multiplexor"; MSV11-R, "4MB Parity Memory Module." Or write the company at 57 N. Main St., Hartford, Wis. 53027. [Circle reader service number 421]

Stationmaster. An IBM Corp. Personal Computer XT or a Compaq Plus centralized work station for the distributed Digi 4 monitor-control network is described in a free 10-page brochure that is illustrated with photographs of menu screens and a typical configuration. The work station lets the user automatically collect and archive data as well as change limits and setpoints. It also collects alarm transmissions and prompts the operator to respond. Request the literature from Kaye Instruments Inc., 15 De Angelo Dr., Bedford, Mass. 01730.
Phone (617) 275-0300 [Circle 423]

Hot stuff. A 112-page guide to Super E-Line (1-W TO-92) transistors includes a product-description section and technical-data section, among other information. The Super E-Line devices operate to 200°C junction temperature, with breakdown voltages specified to 3 V and collector currents specified to 2 A continuous, 6 A pulsed. The manufacturer, Ferranti Electric, says that the packaging eliminates heat sinks. Call (516) 543-1582 for a free copy of the transistor guide or write to 87 Modular Ave., Commack, N.Y. 11725. [Circle 424]

Fill to capacity. Beam-lead and metal-insulator-silicon chip capacitors are the subject of this 20-page brochure, which includes technical information and data sheets on the manufacturer's entire capacitor line. An application note that covers bonding methods and packaging is also included. The brochure is free from the Semiconductor Division of Alpha Industries Inc., whose products extend to binary trimming, FET chip mounting, and millimeter-wave beam-lead capacitors. Write the company at 20 Sylvan Rd., Woburn, Mass. 01801, or call (617) 935-5150. [Circle 425]

Model modems. Mini short-range modems, fiber-optic modems, RS-232-C/RJ-11 adapter kits, and multiplexers are among the products covered in International Data Sciences Inc.'s Data Direct Sales catalog. Reference articles focus on such topics as data-communication testing, high-speed error-rate testing, and more. Illustrated with drawings and photographs, the 72-page catalog describes and specifies each product. Ask for it, free, from IDS at (401) 333-6200 or write to 7 Wellington Rd., Lincoln, R.I. 02865. [Circle 430]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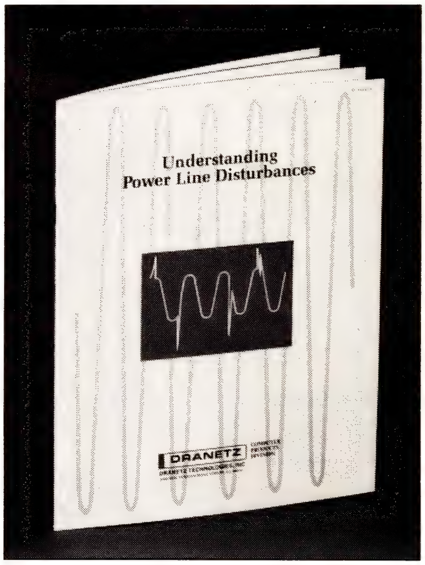
Power up. This power-semiconductor catalog, the first in this product area from Texet Semiconductors, cross-references the company's MOS FETs with those of Siemens, Motorola, and International Rectifier. Specifications and part numbers for both North America and Europe are given. The catalog will be sent at no charge; please request it on company letterhead. Texet Semiconductors is located at 301 Texet Dr., Allen, Texas 75002.
Phone (214) 727-1111 [Circle 427]

Favorable diagnosis. The Network Diagnostic and Test System (NDTS), which uses the IBM Corp. Personal Computer as the central system controller, equips data-communications networks with alarming, monitoring, test-accessing, and switching capabilities. NDTS is described in a free four-page brochure that includes a block diagram and photos of representative screen displays. The system is a product of Digilog Inc.; call them at (215) 628-4530, or write to 1370 Welsh Rd., Montgomeryville, Pa. 18936. [Circle 428]

Do not disturb. A proposed guideline for acceptable ac power for the design of microprocessor-based equipment is one of the topics covered in "Understanding Power Line Disturbances," a free application note. Also discussed are under- and overvoltage conditions and transient impulses on both single-phase and three-phase wye or delta distribution systems, and sag and surge conditions. Frequency variations, a problem with locally generated power, receive coverage as well. This note comes from Dranetz Technologies Inc., Computer Products Division, 1000 New Durham Rd., P.O. Box 4109, Edison, N.J. 08818.
Phone (201) 287-3680 [Circle 426]



Maximum acceleration. The 8694 picotron miniature triaxial accelerometer is described in a free data sheet. Weighing 2.5 g, the unit has a frequency response (±5%) of 0.001 and 20 kHz. Applications are in modal analysis, including development of vehicle suspensions and determination of the sources of problems in missile and aircraft vibration. Kistler Instrument Corp., the manufacturer, touts the unit's high shock resistance, low-impedance signals, and rugged construction. Call the company at (716) 691-5100, or write to 75 John Glenn Dr., Amherst, N.Y. 14120.
(In Canada: Electrodesign Ltd., 1925 52nd Ave., Suite 1, Lachine, Quebec H8T 3C3. Phone [514] 636-4838) [Circle 422]

Horses for hire. More than 890 subfractional-horsepower motors and other motion-control products are covered in this 130-page catalog. Applications for these include instrumentation and robotics. The product groups include STD-bus motor-controller cards; stepper motors; optical encoders; dc motors; and more. STD-bus-compatible pc boards include a 6502-based microcomputer and an 8031-based stepper-motor controller.

Stock Drive Products will send a copy of the catalog free to interested parties. Address requests to 2101 Jericho Tpke., New Hyde Park, N.Y. 11040, or telephone the company at (516) 328-3300. [Circle 429]

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UPCOMING EDITORIAL SCHEDULED FOR ELECTRONICS WEEK MAY 1985 ISSUES	
Issue Date	Editorial Emphasis
May 6	The Realities of Voice and Data Integration
May 13	The Multi-Billion Dollar Field Service Business
May 20	Gallium Arsenide Integrated Circuits
May 27	Computer Graphics Trends

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CUSTOM AND SEMICUSTOM VLSI:
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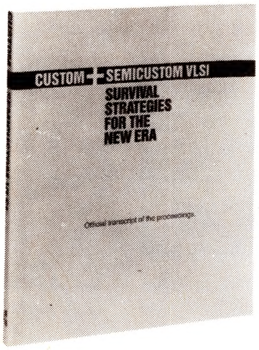
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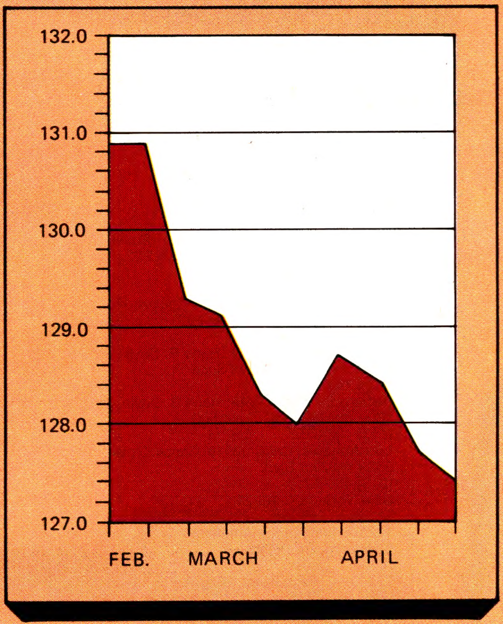
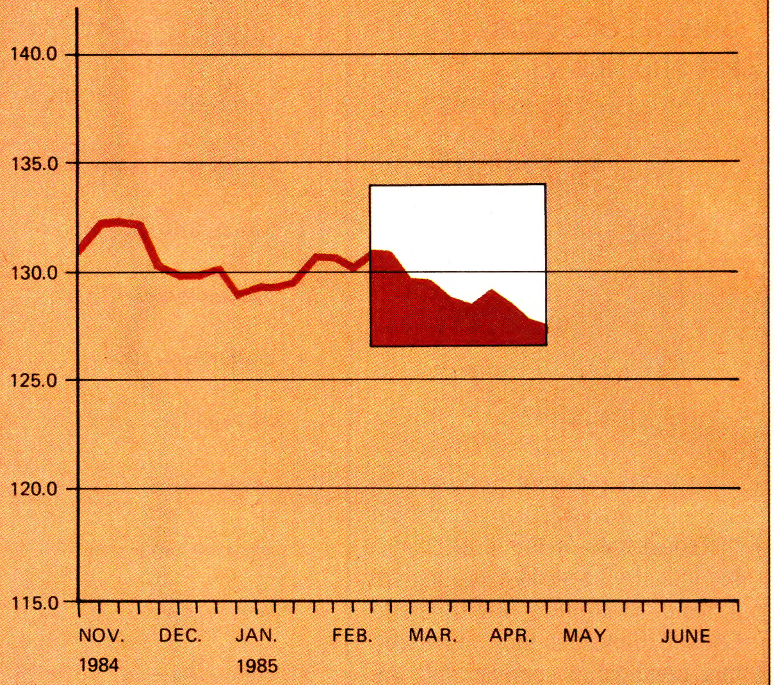
ELECTRONICS WEEK INDEX



THIS WEEK = 127.4
LAST WEEK = 127.7
YEAR AGO = 103.8
1982 = 100.0



The *ElectronicsWeek* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear from week to week.

U.S. ELECTRONICS IMPORTS AND EXPORTS (millions of dollars)

	IMPORTS			EXPORTS		
	February 1985	**January 1985**	**February 1984**	**February 1985**	**January 1985**	**February 1984**
Accounting, computing, and data-processing machines	315.364	416.511	208.578	554.215	669.750	492.703
Calculators	44.680	67.697	32.142	6.456	8.066	7.555
Parts for data-processing machines and office calculators	334.806	392.508	268.405	525.948	611.387	489.063
Telecommunications, sound-recording, and sound-reproducing equipment	1,280.576	1,741.332	1,023.293	313.910	361.749	287.958
Electronic or electric instruments	116.282	131.984	90.712	499.021	567.128	464.978
Printed-circuit boards	26.409	21.428	15.667	24.354	28.822	18.390
Integrated circuits, diodes and other semiconductors, tubes, piezoelectric crystals, parts	555.513	630.816	483.510	374.245	527.050	458.817
Fixed and variable resistors	22.567	23.364	22.542	11.761	15.117	14.639

Despite a sharp decline in U.S. imports of electronics equipment, an almost equally steep drop in U.S. exports of electronics goods pushed the *ElectronicsWeek* Index down slightly in the latest week. Overall, U.S. electronics imports declined 21.3% in February, according to the latest statistics from the U.S. Commerce Department, while exports of U.S.-made goods slipped 17.1% in the same period. Of U.S. exports, semiconductors were the month's big loser, dropping 29% from January. Exports of resistors also fell, by 22%. At the same time, imports of semiconductors fell 12% from the previous month. In the equipment categories, imports of accounting and data-processing equipment dropped 24% as exports declined by 17%. The small differential in the rate of decline between imports and exports was enough to cut February's domestic electronics trade deficit almost 40%, to $386.3 million. Still, that comes as little comfort to an industry that had never experienced a trade deficit until last year. What's more, even though the U.S. dollar's strength has slipped since March, it still remains almost 25% higher than a year ago, which means the U.S. electronics industry can probably expect more trade deficits in the future.

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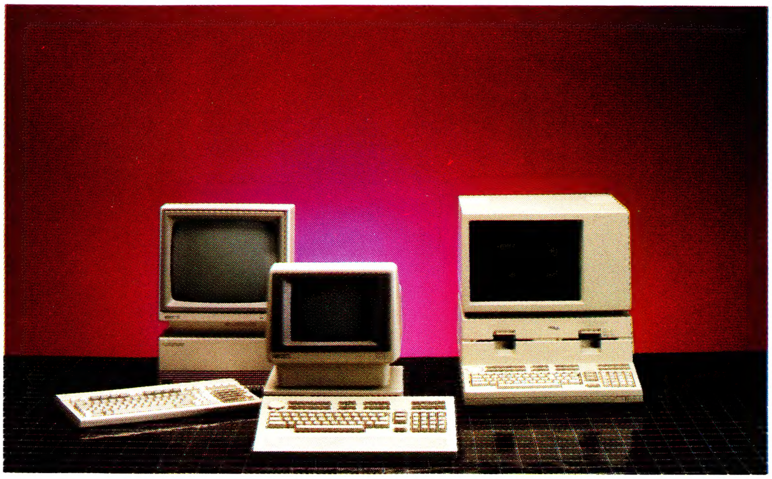
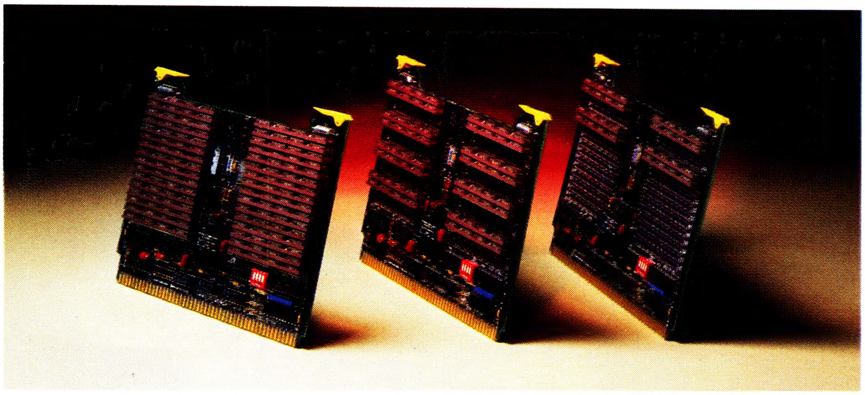


Pictured right: HP 200 Series Computers 217, 216, 236.



Pictured left to right: AM 244 (4MB), AM 242 (2MB), AM 241 (1MB)

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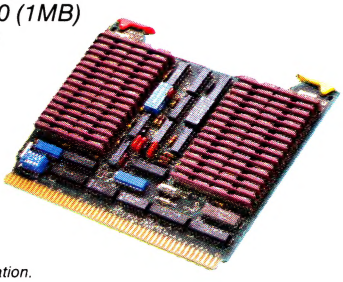

Pictured: AM 200 (1MB) Memory

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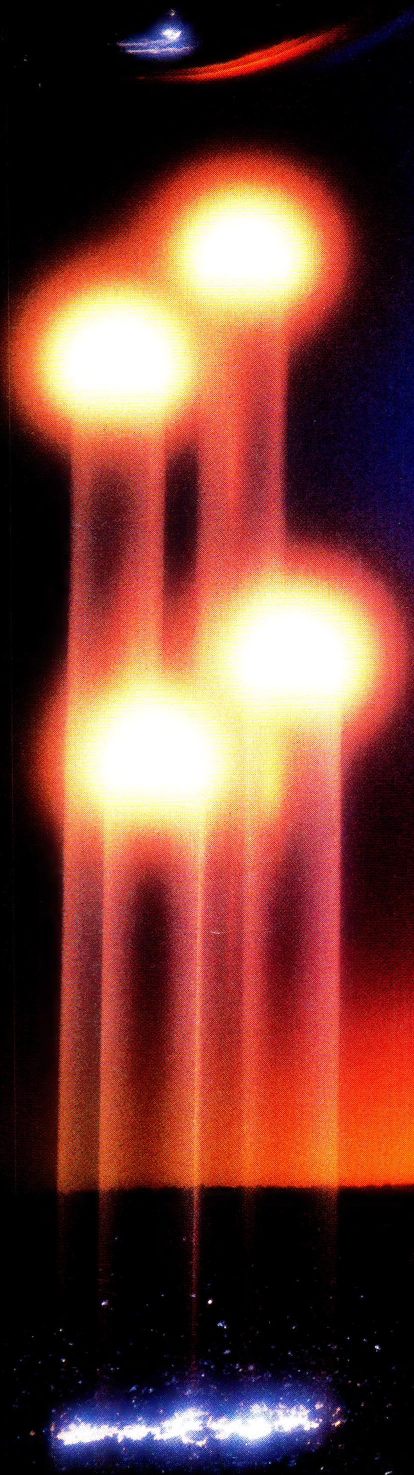

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